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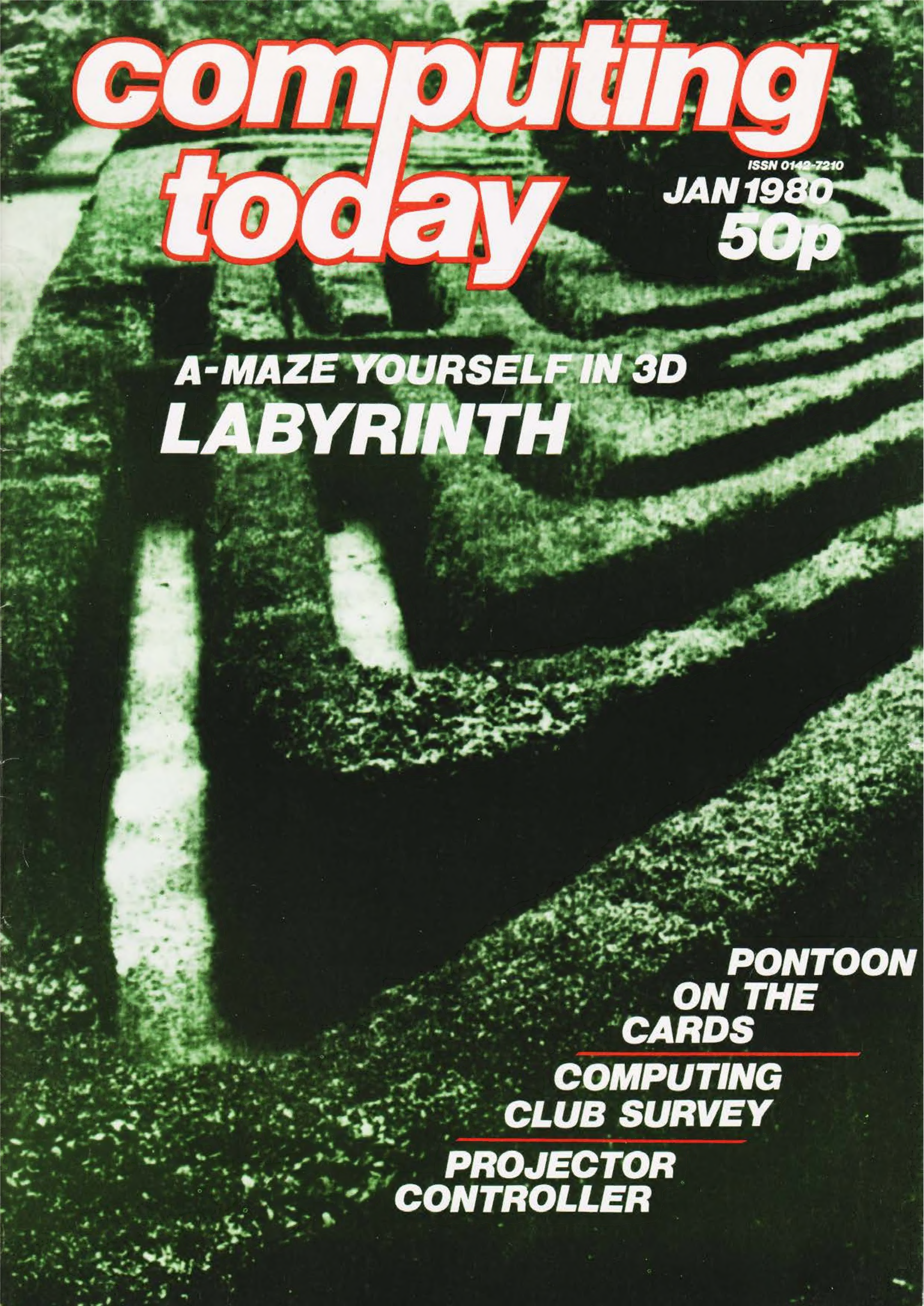

A-MAZE YOURSELF IN 3D LABYRINTH

PONTOON ON THE CARDS

COMPUTING CLUB SURVEY

PROJECTOR CONTROLLER

computing today

VOL. 1 No. 11
JAN. 1980

PAGE

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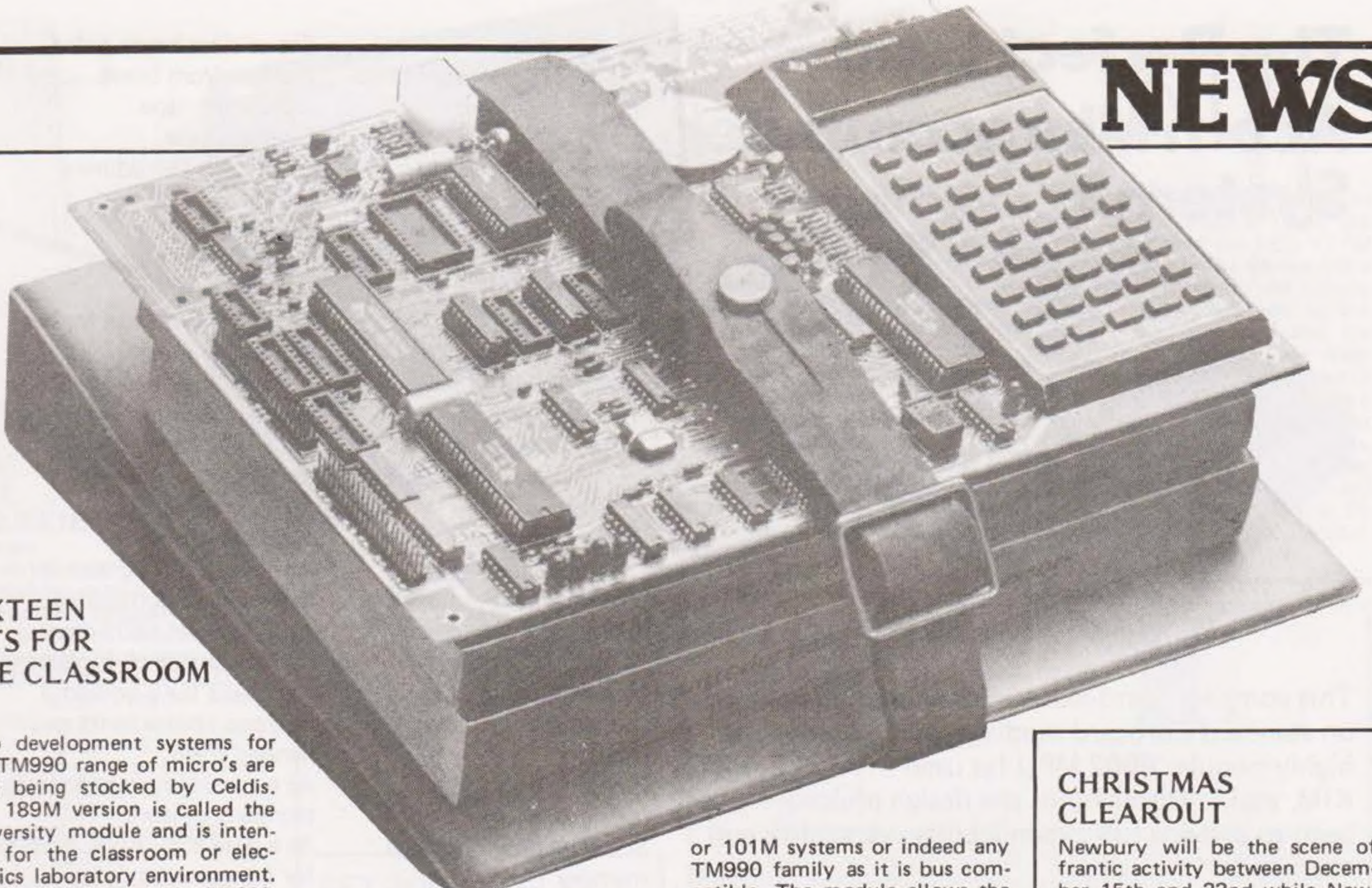


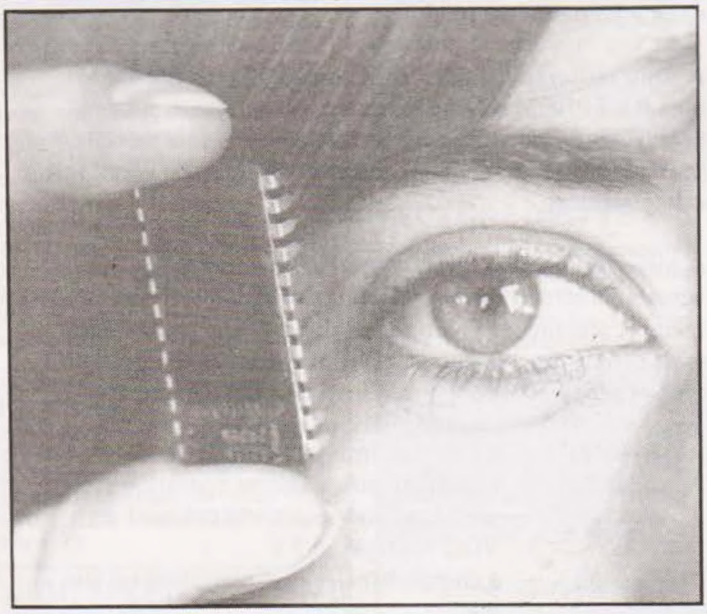
SIXTEEN BITS FOR THE CLASSROOM

Two development systems for the TM990 range of micro's are now being stocked by Celdis. The 189M version is called the University module and is intended for the classroom or electronics laboratory environment. Equipped with RAM, PROM, sixteen bit I/O, alpha-numeric keypad and display as well as the ubiquitous RS232 interface for terminal connection.

Included with the package is a 500 page tutorial manual and a 200 page user manual giving vital details on the cassette interface and the on-board monitor and assembler. The price for a one-off is £256, not unreasonable by comparison with some of the lesser equipped eight bit systems. The second module is the Software Development Module which can be used the 100M or 101M systems or indeed any TM990 family as it is bus compatible. The module allows the editing, assembly and debugging of programs and has dual cassette interfaces for dumping and loading your developed software. For further details contact Celdis Microsystems at 37/39 Loverock Road, Reading, Berkshire.

CHRISTMAS CLEAROUT

Newbury will be the scene of frantic activity between December 15th and 22nd while Newbear are selling off a large range of ex demo equipment at bargain prices. The offers are available only to personal callers at the Newbury and Manchester stores so get down there soon or you'll miss out on the bargain prices.

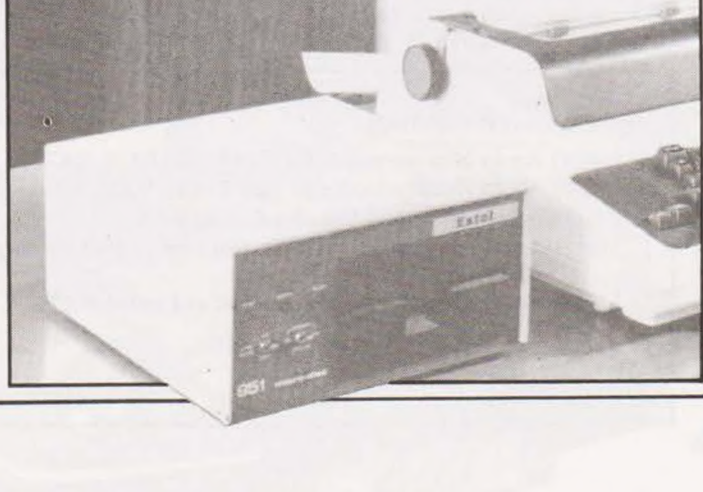


EYE SEE, IC

Petsoft are starting to make deliveries of the Toolkit which we reviewed a month or so ago. The delay is simply due to the fact that so many of you have ordered them, supply and demand equals overload. Shipments are getting through so please don't fret. For those of you who are recent converts the Toolkit is a 2K ROM package that plugs directly into a 16 or 32K PET and gives you a range of editing and debugging tools directly accessible through BASIC. For those of you with the old machines the ROM plugs onto the expansion port on a little PCB. The cost is £55 for the ROM or £75 for the plug-on version. The product is also Commodore approved, it certainly got our commendation as being a very useful piece of kit. For more info contact Petsoft at PO Box 9, Newbury, Berkshire.

EXTEL EXCEL

A mini disc system with full editing facilities has been launched by the Exchange Telegraph Company. The device is RS232 compatible for easy connection to any system and uses Shugart drives to hold over 200K. Facilities offered include global searches, string searches and free-space indication as well as the usual editing functions. All the operating software is built in with a micro and the unit will self initialise your disc automatically which eliminates the need for pre-formatting. The unit costs a hefty £1281 and further details are available from Extel Engineering Division at 73/75 Scrutton Street, London EC2A 4PB.

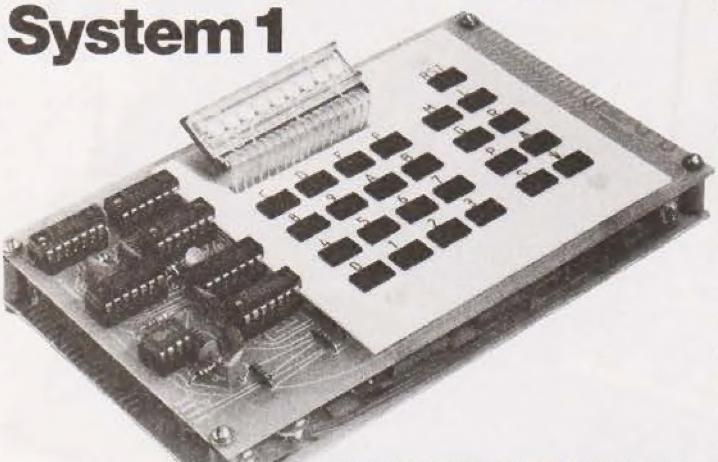


TAKING THE COURSE

A new degree course has been introduced by the University of Leicester called Physics with Microelectronics and Computing. Rather than giving a course solely in Microprocessors they have chosen to include some of everything, hopefully leading to a less specialised course. The ideal graduate should be not only happy in the research environment but also in this environment. The first intake will be in October 1980 and the course lasts for three years with a B.Sc at the end. Full details can be obtained from the Dept of Physics at the University, University Road, Leicester LE1 7RH.

The Perfect Lead...

Acorn Microcomputer System 1



Price £65 plus VAT in kit form

This compact stand-alone microcomputer is based on standard Eurocard modules, and employs the highly popular 6502 MPU (as used in APPLE, PET, KIM, etc). Throughout, the design philosophy has been to provide full expandability, versatility and economy.

Specification

The Acorn consists of two single Eurocards.

1. MPU card

6502 microprocessor
512 x 8 ACORN monitor
1 K x 8 RAM
16-way I/O with 128 bytes of RAM
1 MHz crystal
5 V regulator, sockets for 2K EPROM and second RAM I/O chip.

2. Keyboard card

25 click-keys (16 hex, 9 control)
8 digit, 7 segment display
CUTS standard crystal controlled tape interface circuitry.

Keyboard instructions:

Memory Inspect/Change (remembers last address used)
Stepping up through memory
Stepping down through memory
Set or clear break point
Restore from break
Load from tape
Store on tape
Go (recalls last address used)
Reset

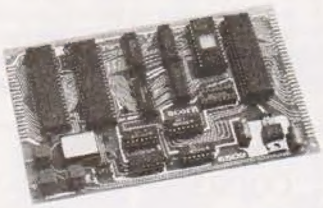
Monitor features

System program
Set of sub-routines for use in programming
Powerful de-bugging facility displays all internal registers
Tape load and store routines

Applications

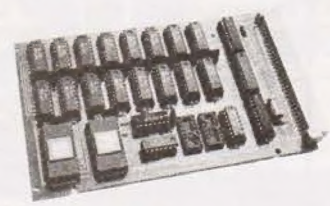
As a self teaching tool for beginners to computing.
As a low cost 6502 development system for industry.
As a basis for a powerful microcomputer in its expanded form.
As a control system for electronics engineers.
As a data acquisition system for laboratories.

START WITH SYSTEM 1 AND CONTINUE AS AND WHEN YOU LIKE



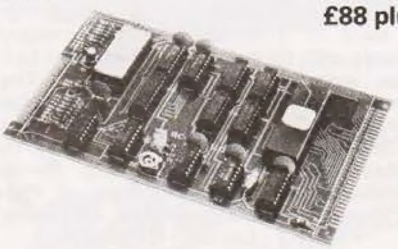
Acorn Controller
£35 plus VAT (min config.)

Based on the CPU card of System 1, it allows for up to 4½ k EPROM, 1¼ k RAM and 32 I/O lines. It has on board 5 V regulator and optional crystal control. Custom programs may be developed on System 1 and the card makes an ideal dedicated hardware module.



Acorn Memory 8 k
£95 plus VAT (kit form)

A fully buffered memory card allowing up to 8 k RAM plus 8 k EPROM on one eurocard, in an Acorn system both BASIC and DOS may be contained in this module. Static RAM (2114) is used and the card may be wired into other systems.



Acorn VDU
£88 plus VAT (kit form)

A memory mapped seven colour VDU interface with adjustable screen format. Full upper and lower ascii and teletext graphics are features of this module which along with programmable cursor, light pen, hardware scroll etc., make this the most advanced interface in its class.

Acorn Software in ROM

Acorn BASIC – a very fast integer BASIC in 4 k
Acorn COS – a sophisticated cassette operating system with load and save and keyboard and VDU routines in 2 k
Acorn DOS – a comprehensive disc operating system in 4 k

Acorn Computers Ltd.
4A Market Hill, Cambridge, Cambs.
Cambridge (0223) 312772.

Order Form

Please send me the following:

☐ (qty) Acorn Microcomputer kit @ £65 plus £9.75 VAT.
☐ (qty) Acorn Memory kit @ £95 plus £14.25 VAT.
☐ (qty) Acorn VDU kit @ £88 plus £13.20 VAT.
☐ (qty) Acorn Power Supply (for System 1 only) @ £5.95 plus £0.89 VAT.
☐ (qty) Acorn Microcomputer assembled and tested @ £79 plus £11.85 VAT.
☐ (qty) Acorn VDU assembled and tested @ £98 plus £14.70 VAT.

Post and packing free on all orders.

I enclose a cheque for £ . . . . .
(indicate total amount) made out to Acorn Computers Ltd.

Please send me further details of this and other Acorn options

Name ______________________
Address ______________________
____
____

ACORN COMPUTER

Acorn Computers Ltd. 4A Market Hill, Cambridge, Cambs. (0223) 312772. Regd. No. 1403810

CT/1/80

SWOPPABLE VISUAL DISPLAY

A new VDU has been introduced by Pragma called the Visual 200. Featuring all the usual goodies such as detachable keyboard, numeric pad and user definable function keys. The range of facilities provided is topped by the provision of an Emulator switch which can be set to mimic a variety of VDU's such as Hazeltine's 1500, the ADDS 520 and the DEC VT-52 among others. The system has a solid state keyboard and a single PCB which should add to the reliability of the unit and the VDU performs its own diagnostics on power-up. Interface is by the standard RS232 at a range of baud rates from 110 to 19,200 with full or half duplex operation. For more of the nitty gritty on the unit contact Pragma at Middlesex House, 29 High Street, Edgware, Middlesex.

REM FOR TREKKIES

We have had an abundance of enquiries concerning our Star Trek program. There are a number of small errors unfortunately, these are:—

```
1030 IF (W>1)+(W>63)
     GOTO 1020
1035 IF E>W GOSUB
     8300; GOTO 600
1100 U=1; V=V+N; H=H+M
8020 IF G*G>(Z*Z+Y*Y)
     RETURN
8500 INPUT 'COURSE
     (0-7)' B
```

The puzzle set by line 1135 is a red herring, it will work on Triton because U is a logical variable. For other machines use:—

IF U=1 THEN......

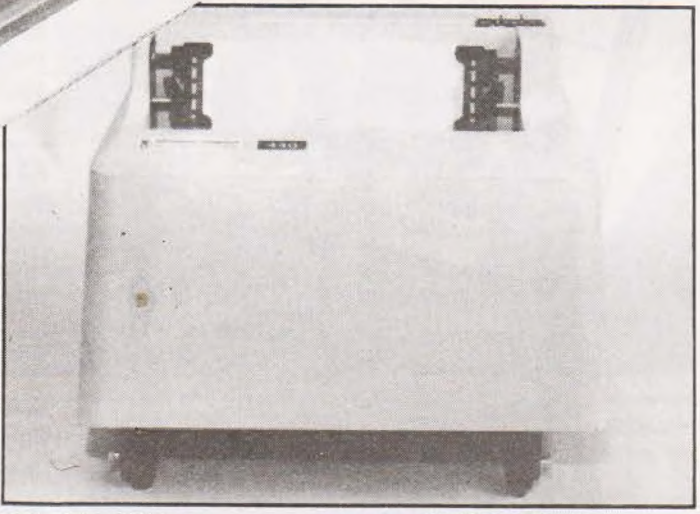
Because the program was written in Integer BASIC you may well have to adjust the movement variables to avoid rambling all round the galaxy, try adding 0.5 and then taken the INT value. On some machines you will need to combine lines 3080 and 3085 to avoid subroutine return problems. Triton uses only one array and it calls it @ so you can change this to a suitable letter, such as A, throughout. You will also need to change the # sign to < > throughout *except* where it occurs in a PRINT statement. In this case the #N defines the space required to print a variable on the screen, adjust or remove this to suit. And finally ... the + sign between brackets in an IF...THEN type statement is generally a logical OR not add. By the way we have taken note of the 0 (zero) or O problem, 0 appears as the torpedo counter in lines 70, 510, 4000 and 4013. Good hunting!

HIGH SPEED CONVERTER

Amplicon have introduced two new high speed analogue to digital converters that handle 16 bits in 100 microseconds. The second model handles 14 bits in a mere 50 microseconds. Both offer a high degree of stability and accuracy, as is to be expected at the prices of £383 and £298 for sixteen and fourteen bits respectively. Amplicon can be contacted at Lion Mews, Hove BN3 5RA or give them a bell on 0273-720716.

PET BOOK SELL OUT

The first edition of PET for Beginners has sold out. Don't fret though, it has been amended and re-published. The book is not a guide to the BASIC language but is most useful to those with PET's and deals with the facilities available on that machine. Our office copy is well used and liked so it should be a good buy for those of you who are into Petting! The booklet costs £1 and can be ordered from PETFOLIO, Innisbeag, Blackhill, Coleraine, N.Ireland BT51 4EU.

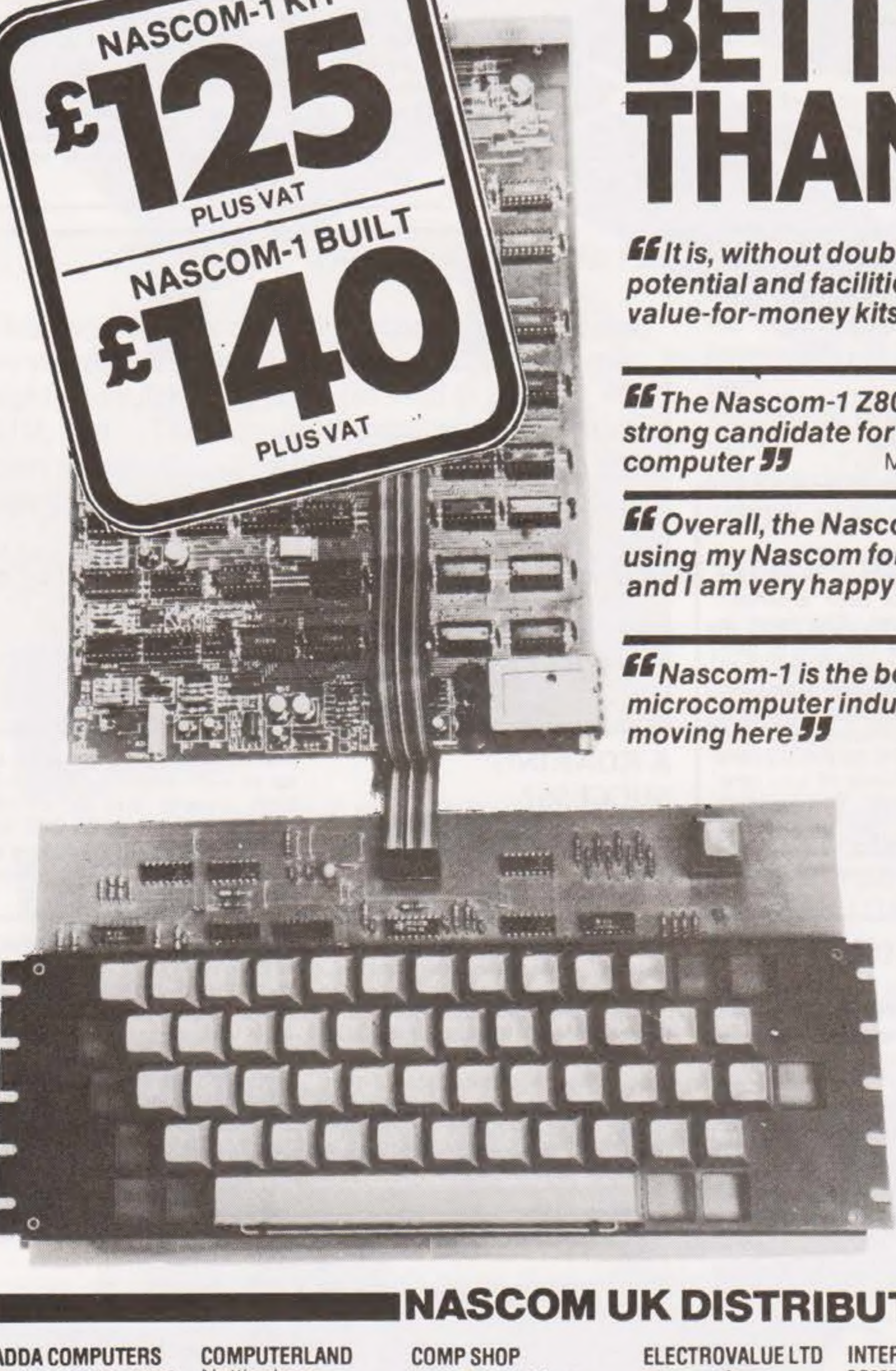


A ROARING SUCCESS?

A new, low cost printer is now marketed by Microsense Computers of Finway Road, Hemel Hempstead, Herts. Featuring the full 96 ASCII character set, up to eight character sizes it has both parallel and serial interfaces and prints at 95 CPS with formats of six or eight lines per inch and 80 or 132 columns. Cost £585.

VECTORED BYTE

The Byte shop and Computerland have got their hands on the Vector Graphics Memorite system just in time for Compec. The system comprises the Vector microcomputer with 48K of memory, a dumb memory mapped terminal and a daisy wheel printer. The unique feature of the system, or so we're told, is the inbuilt word processing logic. The machine can of course run the usual range of languages and software packages that the Byte shop offer. For more details drop in to your local branch or write to 426/428 Cranbrook Road, Gants Hill, Ilford, Essex IG2 6HW.



NEWS

ANCIENT GREEK COMES HOME

Control Data have just announced plans for their new computer based education system called PLATO. The service will be obtainable from the existing seven Learning Centres that they run and a further four will be set up. Based on a dual Cyber 730 system which is being installed in North London and operated from a custom designed interactive terminal it is one of the finest systems I have seen. The first course to be offered over here will be a 60 hour session on Microprocessors. The terminal allows normal keyboard interaction as well as "touch screen" capability and a wide range of course material will be available soon including a course to teach you how to write courses! The price of the micro course is about £500 but this could be cut by installing your own terminals and writing your own material. I shall be taking a closer look at this system soon so watch this space. For more details contact Neil Spoonley at Control Data, 179/199 Shaftesbury Avenue, London WC2H 8AR.

APL MAPLE

For those of you who hanker after new vista's to conquer APL is now available on a micro system. Called MAPLE and produced by A.P.Limited it is based on a Z80/S100system with a full complement of 64K of memory. The interpreter, written by Vanguard Systems, takes 32K, 4K is needed for the CP/M disk operating system and the remaining 28K is left for the user. A complete system with a 12" VDU, twin floppies and a set of software will sell for under £4000. A variety of special features such as exchangeable ASCII and APL character sets and special APL editing keys are obtained by flicking a switch on the VDU making the system very easy to use. Traditional languages such as BASIC, PASCAL and FORTRAN can be run on the system and there is a wide range of software packages available including text processing, statistics and financial analysis.

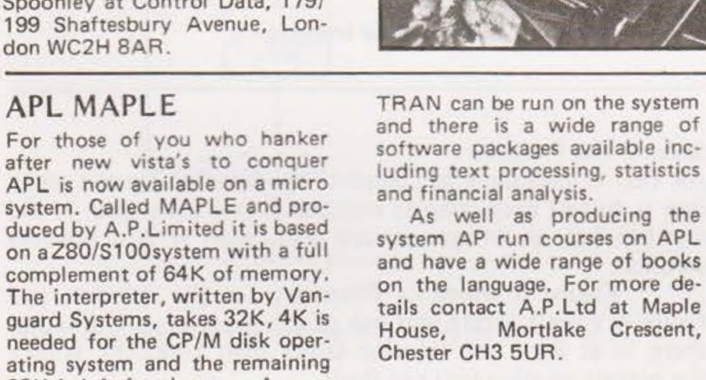
As well as producing the system AP run courses on APL and have a wide range of books on the language. For more details contact A.P.Ltd at Maple House, Mortlake Crescent, Chester CH3 5UR.

HANDS ON PASCAL

Unfortunately you have just missed your chance to get hands-on experience of PASCAL with Dr Kenneth Bowles. Worry not, stop tearing your hair out and leave the cat alone. The course will be run again between January 15 and 18 next year. The course will be based around 15 Apples running PASCAL at ICS/PCL's training headquarters in Holborn. Among the course material will be Dr Bowles own book, Problem Solving using PASCAL, one of the standard works on the language. For more details you should contact The ICS Publishing Company (UK) Limited, Pebblecoombe, Tadworth, Surrey KT20 7PA or ring on 03723-79211.

A CASE FOR NASCOM

Portable Microsystems are packing NASCOM 1's and (hopefully) 2's into neat little boxes, much like what they have already done to the AIM 65. The two cased versions are DTC 80-1 which is a desktop unit complete with power supply and the BCC 80-1 which is a briefcase version with an optional acoustic coupler. Both these options will be available with the "2" when it finally arrives (yawn) but that is NASCOM's problem not ours. You can contact Portable Microsystems at Forby House, 18 Market Place, Brackley, Northants NN13 5SF.



PRESSING ON PRESTEL

ITT, those people who brought you the 2020, are one of the first firms to start up volume production of a wide range of Prestel equipped sets. Among the range of products announced are a 16" colour terminal for the business user, a Viewdata printer that handles the graphics, a message keypad and an editing terminal. Coming soon is a 26" receiver for the home market, complete with Teletext capability and remote control as well. Keep your eyes on your local telly shop for the range and prices.

HOLIDAYS WITH A MICRO

Bored with the Costa Del Whatsit? Fed up with Fettuchini? How about going on a holiday course with your micro. Millfield School in Street, Somerset are offering basic courses in computing and a more advanced computer workshop in their Village of Education this summer. The basic course costs £20 a week and is limited to eight at a sitting, work will be on such skills as flowcharting, BASIC programming and file handling and will be based on the school's PETs. The advanced course will cost £32 and will deal with machine code, computer architecture and other subjects. You are encouraged to bring your own for this one but PETs and KIMs will be available, a maximum of five will take this course at any one time. Residential accommodation is available at £40 including all meals. Get the brochure from the Applications Secretary, Millfield Village of Education, Street, Somerset.

T.Lusty

Having squared your triangles we set you a special problem for Christmas

Let's start this month by taking a look at what happens with my hint. Although the program tests the software rather than the hardware, most micro's (PET, RM 380 Z, etc.) get it wrong, most 'real' computers (IBM, HP, etc.) get it right. Figure 1 shows the listing and run of a program for the RM 380 Z. We can see that the square root always prints the correct value but when we look at the integer part of that value we see that INT(50) = 49! The difference column shows that although the machine prints 50 the stored value is the binary equivalent of 49.999993. The interpreter rounds up for printing and we can achieve a similar result by adding an insignificant trifle, say 0.0001, when we take the integer part of the number.

```
100 REM ******************************
110 REM *                            *
120 REM * PROGRM TO TEST SQUARE ROOT *
130 REM *                            *
140 REM * RML 9K DISC BASIC VER 3.0B *
150 REM *                            *
160 REM * TREVOR L"STY  20TH OCT '79. *
170 REM *                            *
180 REM ******************************
190 PRINT
200 PRINT
210 PRINT "NUMBER","SQUARE","ROOT","INT.PART","DIFFERENCE"
220 PRINT "======","======","====","========","=========="
230 PRINT
240 FOR J=10 TO 100 STEP 10
250 LET S=J*J
260 LET R=SQR(S)
270 PRINT J,S,R,INT(R),R-J
280 NEXT J
290 END
```

```
NUMBER      SQUARE      ROOT       INT.PART     DIFFERENCE
======      ======      ====       ========     ==========

 10          100         10         10           9.53674E-07
 20          400         20         20           1.90735E-06
 30          900         30         30           7.62939E-06
 40          1600        40         40           3.8147E-06
 50          2500        50         49          -7.62939E-06
 60          3600        60         60           3.8147E-06
 70          4900        70         69          -7.62939E-06
 80          6400        80         80           7.62939E-06
 90          8100        90         90           7.62939E-06
 100         10000       100        100          7.62939E-06

>READY
```

Fig.1. What your average computer does with square roots!

Triangle Numbers

To solve our problem, we could generate values for the number of balls that exactly fit into a square and then see if that number also fills a triangle. However, it is easier to do the reverse.

Triangle numbers are generated by adding a sequence of integers.

ie.

$$1 = 1$$
$$3 = 1+2$$
$$6 = 1+2+3$$
$$10 = 1+2+3+4$$

Figure 2 shows how this operation is programmed.

```
100 REM ******************************
110 REM *                            *
120 REM *      TRIANGLE NUMBERS      *
130 REM *                            *
140 REM * RML 9K DISC BASIC VER 3.0B *
150 REM *                            *
160 REM * TREVOR LUSTY   25TH OCT 79 *
170 REM *                            *
180 REM ******************************
190 LET N=1
200 LET T=1
210 FOR I=1 TO N
220 PRINT "*";
230 NEXT I
240 PRINT TAB(30);T
250 LET N=N+1
260 LET T=T+N
270 IF T<200 THEN 210
280 END
```

```
*                             1
**                            3
***                           6
****                          10
*****                         15
******                        21
*******                       28
********                      36
*********                     45
**********                    55
***********                   66
************                  78
*************                 91
**************                105
***************               120
****************              136
*****************             153
******************            171
*******************           190

>READY
```

Fig.2. The program for triangles.

Solving The Problem

All that is necessary to complete the solution for the problem is to test each triangle number as it is generated. If the number has an integer square root, then it is a possible solution.

Figure 3 shows a flowchart for the solution and figure 4 gives a listing and run of the program. I know that there is at least one solution larger than 1000000. What's the biggest solution you can find?

Knight In White Boxes

You might have more time to yourself this month, so here's a problem that is definitely time-consuming. Just the thing for when you are immobile.

A Knight's Tour is one where a chess knight starts from anywhere on a chess board and visits each square in turn, once, and only once. The 18th-century mathematician Leonhard Euler made a square (Figure 5) where each horizontal or vertical row totals 260, stopping halfway gives 130, and the 16 two by two squares contained within the larger square also total 130. Even more intriguing is that a chess knight, starting its L — shaped moves from box 1, can hit all 64 squares in numerical order.

Your task, should you be prepared to accept it, is to write a BASIC program for a Knight's Tour.

Please note that this series of problems is designed for YOU to try at home. Much correspondence has been received with answers to the problems but please don't send them to us as we know the answers already!

PROBLEM PAGE

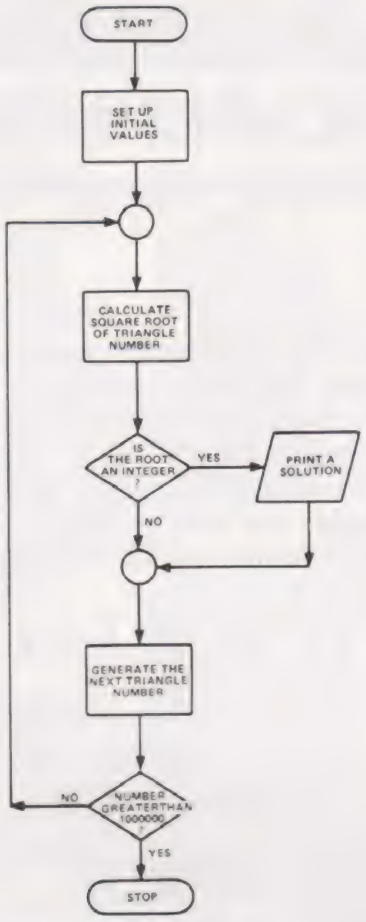


Fig.3. Flowchart for the program that solves the problem.

```
100 REM ********************************
110 REM *                              *
120 REM * SQUARE TRIANGLES - SOLUTION  *
130 REM *                              *
140 REM * RML 9K DISC BASIC VER 3.0B   *
150 REM *                              *
160 REM * TREVOR LUSTY    25TH OCT 79  *
170 REM *                              *
180 REM ********************************
190 LET N=2
200 LET T=3
210 LET S=SQR(T)
220 LET S=INT(S+0.0001)
230 IF ABS(T-S*S)>0.0001 THEN 290
240 PRINT "NUMBER ØF BALLS IS";T
250 PRINT "SIDE OF SQUARE IS";S;"BALLS LONG"
260 PRINT "SIDE OF TRIANGLE IS";N;"BALLS LONG"
270 PRINT
280 PRINT
290 LET N=N+1
300 LET T=T+N
310 IF T<1000001 THEN 210
320 END


NUMBER ØF BALLS IS 36
SIDE OF SQUARE IS 6 BALLS LONG
SIDE OF TRIANGLE IS 8 BALLS LONG


NUMBER ØF BALLS IS 1225
SIDE OF SQUARE IS 35 BALLS LONG
SIDE OF TRIANGLE IS 49 BALLS LONG


NUMBER ØF BALLS IS 41616
SIDE OF SQUARE IS 204 BALLS LONG
SIDE OF TRIANGLE IS 288 BALLS LONG
```

Fig.4. The final solution to the problem.

1	48	31	50	33	16	63	18
30	51	46	3	62	19	14	35
47	2	49	32	15	34	17	64
52	29	4	45	20	61	36	13
5	44	25	56	9	40	21	60
28	53	8	41	24	57	12	37
43	6	55	26	39	10	59	22
54	27	42	7	58	23	38	11

Fig.5. The grid chart for Knights touring.

"I JUST CAN'T GET THAT PROGRAM RIGHT!"

electronics today international

What to look for in the February issue: on sale January 2nd

CMOS 555

Now you all know about the CMOS version of the 555 timer chip — because we told you about it last month in Designers Notebook, so no excuses in the back row please.

Only thing to do now was to get Tim Orr, the country's leading circuit man, to spend a few eons playing with the device and produce one of his superb circuit filled features all across ETIs pages next month. This is good stuff of the highest quality. Be there with your soldering irons, there are circuits for just about everything under the sun — and if we can find a heater element big enough we'll see you with a design for one of them next year.

ONE FIVE THREE SEVEN

Whatdeyer mean that you've never heard of this? Of course you have. It's a brilliant Voltage Controlled Attenuator thingy for which Keith Brindley will explain at least a million applications and designs next month. Well, not actually a million but quite a few. He also gives you a breadboard design to go away and do your own things with. What more could you possibly want? Stand up the boy in the back who said "Felicity Kendal".

MODULAR SYNTHESISER

Next month ETI presents a new series of synthesiser circuit modules which represent the forefront of modern music technology. Not only that but they're a bit new as well. And somewhat of a departure for us. The complete design will be a sophisticated machine comparable to the very best available today at any price and with more facilities than the Playboy Club.

However we are aware that not everyone has a use for such a machine, and that there are a large number of you out there who wish to experiment with sound effects circuits, without the requirement for a fully fledged synthesiser system. And So . . .

Our latest machine will be presented in modular form, with each separate unit mounted on a 'front panel' assembly, *and* housed in a common box. As the PSU requirements will be standardised, you can build as many — or as few — of these superb designs as you need when you need them.

CASIO FX502P/FA1

The best thing since sliced bread. Honest. If you don't believe us read our comprehensive report on this ten program 256 step, 100 label, cassette jumping calculator and music adaptor in next month's ETI.

The abacus will never seem the same again.

CASSETTE HEAD DEMAGNETISER

Sometimes we're so ingenious we amaze ourselves! And sometimes we're so dumb we amaze everyone else.

Apart from that though this *is* a good idea — demagnetising your cassette player heads reduces all the nasty things that you don't really wanna hear anyway and makes those that you do sound even better.

Ours naturally has something a bit special about it — something that makes it both easy to use and more effective. But we're not gonna tell you what cos we want yer to buy next month's magazine instead!

VMOS 2M PA

One for all the hams of this world. Put some POWER in your words with our VFET Power Amp. Based on the latest circuit techniques this is a design to burn out the receivers of the universe. Don't just broadcast — BROADCAST with ETI!

SIGNAL TRACER

This is instead the only way to find that sinewave that went into that phono socket half an hour ago and hasn't come out yet.

For the sake of all lost waveforms everywhere build this one.

interface components

NASCOM's NEW BIG DISTRIBUTOR

No more slaving over a hot soldering iron – the Nascom 1 is now supplied BUILT!
Britain's biggest small system is available fully constructed for you to slot into your own housing for the ridiculously low price of £140 plus VAT (kit price still only £125 plus VAT).

nascom-1

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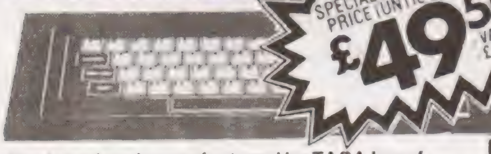

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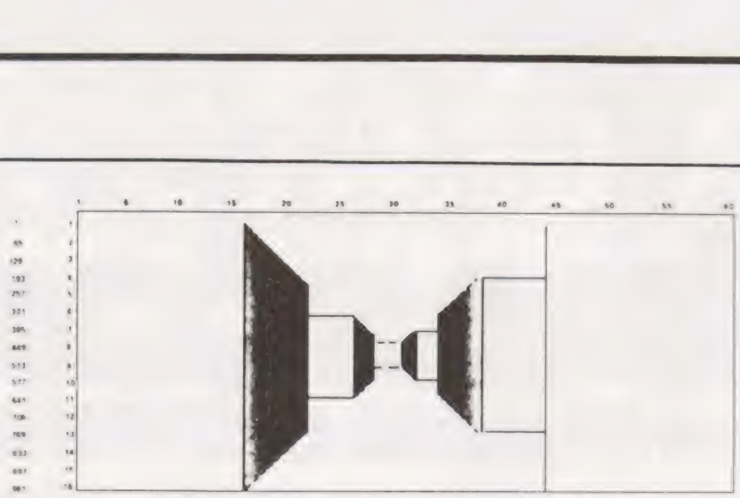


Labyrinth is a fairly large program written in Tiny BASIC. Each time the program is run it will construct a different two dimensional maze and then allow the player to explore a three dimensional projection of this maze.

The program is divided roughly into two halves. The first half randomly builds a maze with a single route through it. A 2D plot of the maze is available at the end of this stage for those who suffer from claustrophobia. The second half of the program produces 3D projections as the player wanders along the corridors of the maze.

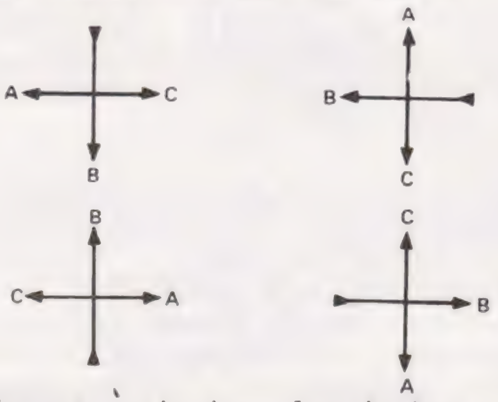
Building The Maze

The basic maze is a 'simple connected' maze (one which has no closed circuits). It is constructed using two, two dimensional arrays. The first array holds an indication of which cells of the maze have been used and the order in which they have been allocated. The second array holds the description of the topology of the maze.

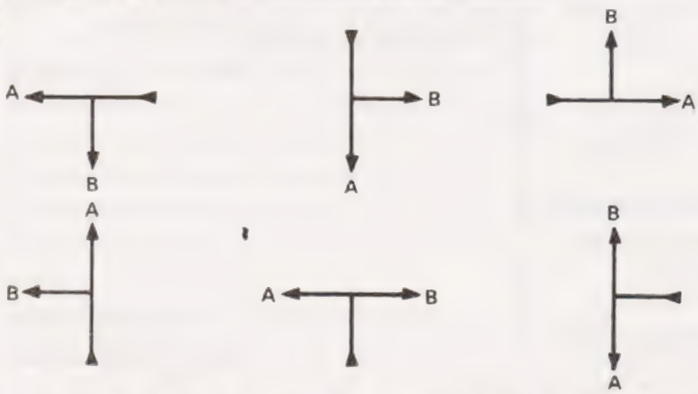
The maze construction starts by randomly selecting an entrance along the width of the maze. This location is saved in a spare element of the array.

From this start location the maze is constructed. At each cell, the program scans the adjacent cells to see which are available to use. Having decided which are available, the program then selects one cell randomly.

Consider the following examples. In each of these four there are three possible choices, A, B and C



hence the route can be chosen from the three possibilities. Next there are six combinations of two choices.



To arrive at these choices, the program must first scan the adjacent cells. As the program knows the direction it has just come from, it only needs to check the other three directions.

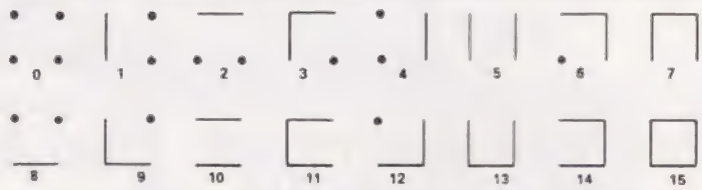
The program continues its random route through the maze until it hits a dead end. A branch is then made from the first route at this point and continued until the next dead end. This procedure is continued until the maze is complete.

At this point, the player can obtain a two dimensional display of the maze. Each element of the second array contains information about one cell of the maze. This information is incomplete as it is only for the top and right hand wall.

0= 1= 2= 3=

The Third Dimension

To produce a three dimensional picture, it is necessary to complete the cell information and organize it in such a manner that it can be rotated. The binary system fulfils both these requirements. A bit is used to indicate a wall. So we get



To turn left, the cell information is cyclicically shifted right one bit. 2 becomes 4, 3 becomes 6, 8 becomes 1. To turn right, the cell information is cyclicically shifted left one bit. 2 becomes 1, 1 becomes 8, 10 becomes 5.

The information for the 2d maze is therefore translated and the information completed by inspecting the neighbouring cells. The 3D pictures are produced using memory mapping and the graphics available on the TRITON. As most systems have both memory mapped displays and graphic symbols, it should be very easy to convert this part of the program to run on most machines.

The display is constructed simply with horizontal, vertical and diagonal lines. A reasonable display would be possible with I – and / \ To move in the maze, the player can turn left or right or move forward. The players current position can also be obtained.

Giving The Picture

To produce the 3D picture, the program starts with the cell corresponding to the players current position. This cell is then rotated, as described earlier, until facing the same way as the player. The program then decodes the cell information and checks for the walls left, right and in front of the player. At the first depth, either a blank wall or two columns are produced. If a blank wall is produced, no further information is available. If looking out of the maze, no further information is produced and if outside the maze and looking away from it, a blank screen is all you get.

If, on the other hand, a passage exists to the next cell, the program obtains the information about the next cell by making the appropriate index and rotates and decodes this cell. At the second depth, it is possible to have walls or passages to the left, right and straight ahead.

Each depth has its own display routine which checks for and plots the three walls or passages. Each depth produces a display continuing from the previous and maintains the perspective. The display stops either with a blank wall or when depth 5 has been reached.

The program listing following contains the full Tiny BASIC commands and is commented to make it easier to follow and to translate. If using a floating point BASIC, take great care in the rotate and decode routines as they rely on integer rounding effects. A large number of INT commands will be required.

The program will fit on a TRITON with mother board and an extra 8K of static RAM but the Tiny BASIC commands should be abbreviated for size and speed reasons. A tape of the program in abbreviated Tiny BASIC is available from TRANSAM of Chapel Street, London.

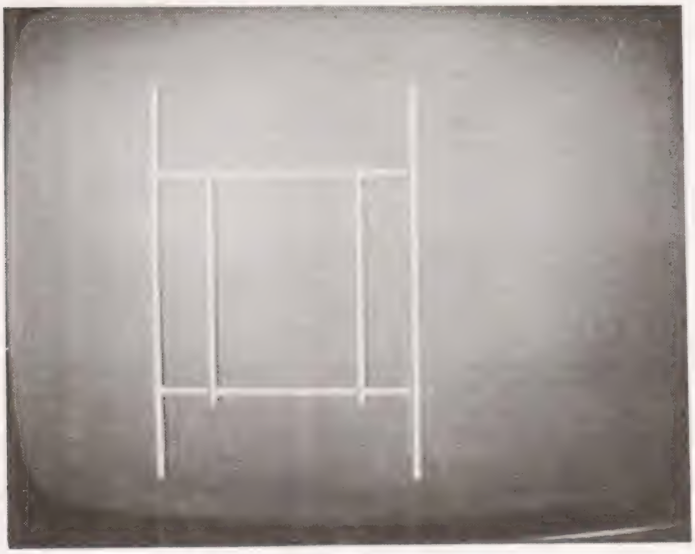
Program Notes

LINE NUMBERS	
5–40	Clear Screen and print heading.
45–70	Ask for size of maze.
95–120	Clear arrays used to construct the maze and initialize variables. Obtain random entry point.
125–150	Save entry point and start the maze.
155–1295	Maze build routine.
155–200	Finds the next starting point when a route comes to a dead end.
210–270	Does an initial check on the number of allowable routes from the current position in the maze.
275–310	Randomly select Left, Down or Right as the next route.
320–350	More route checking. Z = 1 when an exit exists.
355–390	Randomly select Left, Down or Up.
395–410	Use when exit already exists or no way up. Randomly select Left or Down.
420–470	Move route checking.
475–510	Randomly select Left, Right or Up.
515–530	No way up. Randomly select Left or Right.
540–570	Move route checking.
575–600	Randomly select Left or Up.
610–680	Move route checking.
685–720	Randomly select Down, Right or Up.
725–740	No way up, select Down or Right.
750–780	Yet more route checking.
785–810	Just Down or Up.
820–870	Not much more route to check.
875–900	Right or Up.
910–950	Last bit of route checking.
955–990	Set up maze for route to go Left. Check if maze finished, if not, see where it goes next.
995–1030	Route goes Down.
1035–1100	Route goes Right.
1105–1160	Route goes Up. Checks if exit made.
1165–1200	Make exit at top, loop back if maze not complete.
1205–1210	Make sure maze has an exit.
1300–1320	Keyboard scan to see if 2D print required. READ 0, I scans a byte from the keyboard on the Triton. Substitute INPUT if necessary.
1330–1570	2D print routine.
1330–1335	Clear screen and print 'CHEAT'.
1340	Loop for height of maze.
1350–1420	Print the top of a line of cells checking to see if wall or gap required. To use Triton graphics change + to w and – to s.
1430–1500	Print the sides of a line of cells, checking to see if wall or gap required. To use Triton graphics change I to t.
1510	End of height loop.
1520–1570	Print bottom of last row of cells, leaving an entrance.
1595–1620	Reset cursor to top of screen and loop on the keyboard until a key is pressed. Again, INPUT can be substituted.
1625–1630	Call the instruction print routine.
1635–1870	Translate the maze into binary cell information and then give each cell the information about all its walls.
1635–1670	Translate maze to convenient notation and move into other buffer.
1710–1870	Take each cell in turn and check with adjacent cells to obtain information about all the walls.
1875–1890	Set up start parameters and go display entrance to maze in 3D.
1895–1950	Print instruction for wandering in maze.
1995–2100	Print helpful information when lost. Note the Λ] and ΛJ which perform a carriage return without clearing the screen and a line feed.
2195–2270	Another keyboard scan routine. Routine loops scanning the keyboard until L, R, F or H are pressed. When pressed it jumps to the appropriate routine. No real problem to substitute INPUT.
2295–2320	Turn Left, then go display new view.
2345–2370	Turn Right, and go display new view.
2395–2440	Clear screen and wait while it is cleared. VDU 0, 12 is the clear screen command for a Triton.
2445–2460	Reset cursor to top of screen and wait. VDU 0, 28 is the reset cursor command.
2495–2540	Routine to space cursor and erase messages.
2595–2790	Rotate routine.
2595–2630	Check current position (A,B) and extract cell information if inside maze.
2635–2660	Rotate the cell information if not facing north until facing right direction.
2670–2700	Decode the cell information into C, D and E.

	C is Left wall, D is Right wall and E is front wall. If zero no wall and if one, a wall.
2705–2750	Set up if outside maze but facing retaining wall.
2755–2790	Set up if in NO MANS LAND.
2795–2850	Index the display to the next cell according to direction faced.
2855–2920	Position cursor for messages. ΛJ and ΛI perform line feed and cursor right commands on the Triton.
2930–2980	Print error messages when you hit a dead end or no mans land.
2995–3040	Routine to move the player forward to the next cell.
3045–4980	3D display routines.
3045–3060	Set up start position, rotate and look from 1st cell.
3065–3080	Set up loop for up to 5 depths and call display routine.
3085–3140	Check if possible to see into next cell. If so, index to and rotate next cell. Loop to a depth of 5 unless wall in way. Return to keyboard routine.
3195–3200	Jump to appropriate depth routine.
3205–3300	Clear screen and check if facing no mans land, if yes, nothing to display. Otherwise display first depth.
3240–3270	Map vertical lines of walls. Triton screen is 64 wide by 16 high. The screen is numbered left to right, top to bottom from 1 to 1024. VDU I,116 maps graphic 116 at the location in I.
3280–3330	Check for a wall ahead and if so map top and bottom. Graphic 107 is and 108 is .
3600–3940	Display second depth.
3600–3720	Check for left wall or passage and map projection. Graphic 114 is \, 113 is /.
3730–3840	Check for right wall or passage and map.
3850–3880	Map end walls.
3890–3940	Check for end wall, return if no wall otherwise map top and bottom.
4000–4300	Display third depth.
4400–4620	Display fourth depth.
4800–4980	Display fifth depth. Graphic 106 is | and 105 is |.
4995–5030	Clear screen and display WAY OUT. End of game.

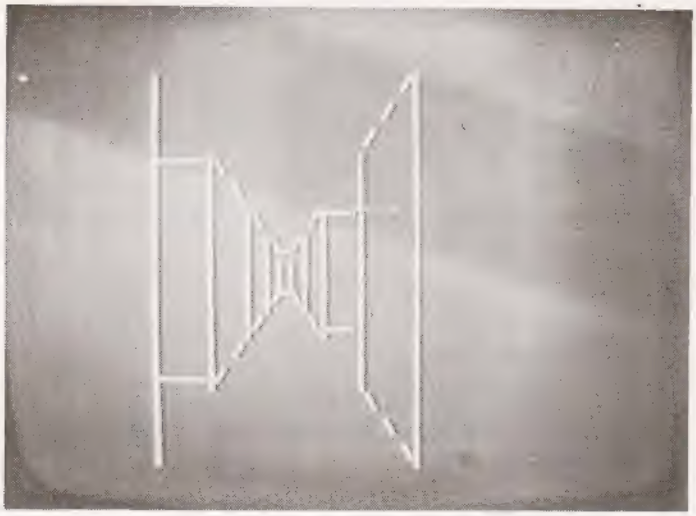
```
5 REM-CLEAR SCREEN AND PRINT HEADING
10 GOSUB 2400
20 PRINT "     ***********
30 PRINT "     *LABYRINTH*
40 PRINT "     ***********
45 REM-GET MAZE DIMENSIONS
50 PRINT "ENTER SIZE OF MAZE
60 INPUT WIDTH H, HEIGHT V
70 PRINT "THINKING
95 REM-CLEAR MAZE ARRAY
100 A=H*V+1
110 FOR I=1 TO A+A:@(I)=0:NEXT I
120 Q=0:Z=0:X=RND(H)
125 REM-SAVE MAZE ENTRY POINT
130 @(A)=X
140 @(X)=1:C=2
150 R=X:S=1:GOTO 220
155 REM-START OF MAZE BUILD ROUTINE
160 IF R#H GOTO 200
170 IF S#V GOTO 190
180 R=1:S=1:GOTO 210
190 R=1:S=S+1:GOTO 210
200 R=R+1
210 IF @(R+(S-1)*H)=0 GOTO 160
220 IF R-1=0 GOTO 610
230 IF @(R-1+(S-1)*H)#0 GOTO 610
240 IF S-1=0 GOTO 420
250 IF @(R+(S-2)*H)#0 GOTO 420
260 IF R=H GOTO 320
270 IF @(R+1+(S-1)*H)#0 GOTO 320
275 REM-LEFT/DOWN/RIGHT
280 X=RND(3)
290 IF X=1 GOTO 960
300 IF X=2 GOTO 1000
310 GOTO 1040
320 IF S#V GOTO 350
330 IF Z=1 GOTO 400
340 Q=1:GOTO 360
350 IF @(R+S*H)#0 GOTO 400
355 REM-LEFT/DOWN/UP
360 X=RND(3)
370 IF X=1 GOTO 960
380 IF X=2 GOTO 1000
390 GOTO 1110
395 REM-LEFT/DOWN
400 X=RND(2)
410 GOTO 370
420 IF R=H GOTO 540
430 IF @(R+1+(S-1)*H)#0 GOTO 540
440 IF S#V GOTO 470
450 IF Z=1 GOTO 520
460 Q=1:GOTO 480
470 IF @(R+S*H)#0 GOTO 520
475 REM-LEFT/RIGHT/UP
480 X=RND(3)
490 IF X=1 GOTO 960
500 IF X=2 GOTO 1040
510 GOTO 1110
515 REM-LEFT/RIGHT
520 X=RND(2)
530 GOTO 490
540 IF S#V GOTO 570
550 IF Z=1 GOTO 960
560 Q=1:GOTO 580
570 IF @(R+S*H)#0 GOTO 960
575 REM-LEFT/UP
580 X=RND(2)
590 IF X=1 GOTO 960
600 GOTO 1110
610 IF S-1=0 GOTO 820
620 IF @(R+(S-2)*H)#0 GOTO 820
630 IF R=H GOTO 750
640 IF @(R+1+(S-1)*H)#0 GOTO 750
650 IF S#V GOTO 680
660 IF Z=1 GOTO 730
670 Q=1:GOTO 690
680 IF @(R+S*H)#0 GOTO 730
```

```
685 REM-DOWN/RIGHT/UP
690 X=RND(3)
700 IF X=1 GOTO 1000
710 IF X=2 GOTO 1040
720 GOTO 1110
725 REM-DOWN/RIGHT
730 X=RND(2)
740 GOTO 700
750 IF S*V GOTO 780
760 IF Z=1 GOTO 1000
770 Q=1:GOTO 790
780 IF @(R+S*H)*0 GOTO 1000
785 REM-DOWN/UP
790 X=RND(2)
800 IF X=1 GOTO 1000
810 GOTO 1110
820 IF R=H GOTO 910
830 IF @(R+1+(S-1)*H)*0 GOTO 910
840 IF S*V GOTO 870
850 IF Z=1 GOTO 1040
860 Q=1:GOTO 880
870 IF @(R+S*H)*0 GOTO 1040
875 REM-RIGHT/UP
880 X=RND(2)
890 IF X=1 GOTO 1040
900 GOTO 1110
910 IF S*V GOTO 940
920 IF Z=1 GOTO 160
930 Q=1:GOTO 950
940 IF @(R+S*H)*0 GOTO 150
950 GOTO 1110
955 REM-LEFT
960 @(R-1+(S-1)*H)=C
970 C=C+1,@(A+R-1+(S-1)*H)=2,R=R-1
980 IF C=A GOTO 1210
990 Q=0:GOTO 220
995 REM-DOWN
1000 @(R+(S-2)*H)=C
1010 C=C+1
1020 @(A+R+(S-2)*H)=1,S=S-1:IF C=A GOTO 1210
1030 Q=0:GOTO 220
1035 REM-RIGHT
1040 @(R+1+(S-1)*H)=C
1050 C=C+1:IF @(A+R+(S-1)*H)=0 GOTO 1070
1060 @(A+R+(S-1)*H)=3:GOTO 1030
1070 @(A+R+(S-1)*H)=2
1080 R=R+1
1090 IF C=A GOTO 1210
1100 GOTO 610
1105 REM-UP
1110 IF Q=1 GOTO 1170
1120 @(R+S*H)=C,C=C+1:IF @(A+R+(S-1)*H)=0 GOTO 1140
1130 @(A+R+(S-1)*H)=3:GOTO 1150
1140 @(A+R+(S-1)*H)=1
```

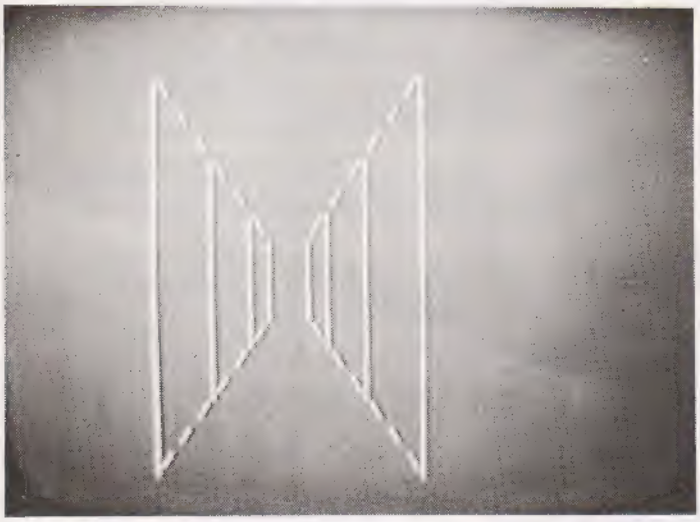


```
1150 S=S+1:IF C=A GOTO 1210
1160 GOTO 220
1165 REM-EXIT AT TOP OF SCREEN
1170 Z=1
1180 IF @(A+R+(S-1)*H)=0 GOTO 1200
1190 @(A+R+(S-1)*H)=3,Q=0;GOTO 160
1200 @(A+R+(S-1)*H)=1,Q=0,R=1,S=1:GOTO 210
1205 REM-MAKE EXIT IF NOT THERE
1210 IF Z*1 X=A+RND(H)+(V-1)*H,@(X)=@(X)+1
1295 REM-END OF MAZE BUILD
1300 PRINT 'DO YOU WANT TO SEE THE MAZE? ',
1310 READ 0,I:IF I<128 GOTO 1310
1320 IF I*249 GOTO 1630
1330 GOSUB 2400:PRINT 'CHEAT!!!!'
1335 REM-2D DISPLAY ROUTINE
1340 FOR J=V TO 1 STEP -1
1350 FOR I=1 TO H
1360 IF @(A+I+(J-1)*H)=0 GOTO 1400
1370 IF @(A+I+(J-1)*H)=2 GOTO 1400
1375 REM-PRINT TOP OF CELLS
1380 PRINT '+  ',
1390 GOTO 1410
1400 PRINT '+--',
1410 NEXT I
1420 PRINT '+'
1430 PRINT 'I',
1440 FOR I=1 TO H
1450 IF @(A+I+(J-1)*H)<2 GOTO 1480
1455 REM-PRINT SIDES OF CELLS
1460 PRINT '   ',
1470 GOTO 1490
1480 PRINT '  I',
1490 NEXT I
1500 PRINT
1510 NEXT J
1520 FOR I=1 TO H
1530 IF I=@(A) GOTO 1550
1535 REM-PRINT BOTTOM OF MAZE
1540 PRINT '+--',:GOTO 1560
1550 PRINT '+  ',
1560 NEXT I
1570 PRINT '+'
1595 REM-PAUSE FOR VIEWING
1600 GOSUB 2450
1610 PRINT 'READY    ',
1620 READ 0,I:IF I<128 GOTO 1620
1625 REM-PRINT INSTRUCTION
1630 GOSUB 1900
1635 REM-TRANSLATE ROUTINE
1640 FOR I=1 TO A-1
1650 J=I+A
1660 @(I)=(3-@(J))*2
1670 NEXT I
1710 W=@(A)
1715 REM-COMPLETE CELL INFORMATION
```

```
1720 FOR J=1 TO V
1730 K=(J-1)*H
1740 FOR I=1 TO H
1750 L=I+K
1760 IF J#1 GOTO 1790
1770 IF I=W GOTO 1820
1780 M=1:GOTO 1810
1790 M=@(L-H)/2
1800 M=M-(M/2)*2
1810 @(L)=@(L)+M*8
1820 IF I=1 M=1:GOTO 1850
1830 M=@(L-1)/4
1840 M=M-(M/2)*2
1850 @(L)=@(L)+M
1860 NEXT I
1870 NEXT J
1875 REM-SET UP START FRAME
1880 X=W,Y=0,Z=1
1890 GOTO 3050
1895 REM-INSTRUCTION PRINTOUT
1900 GOSUB 2400
1910 PRINT "ENTER L TO TURN LEFT"
1920 PRINT "      R TO TURN RIGHT"
1930 PRINT "      F TO GO FORWARD"
1940 PRINT "      H FOR HELP"
1950 RETURN
1995 REM-HELP ROUTINE
2000 PRINT "YOU ARE AT",']','J,
2010 PRINT *1,X," EAST ",']','J,
2020 PRINT *1,Y," NORTH ",']','J,
2030 PRINT "YOU ARE FACING ",']','J,
2040 IF Z=1 PRINT "NORTH",
2050 IF Z=2 PRINT "EAST ",
2060 IF Z=3 PRINT "SOUTH",
2070 IF Z=4 PRINT "WEST ",
2080 PRINT ']','J,
2090 GOSUB 2450
2100 GOTO 2200
2195 REM-KEYBOARD ROUTINE
2200 IF Y>V GOTO 5000
2210 READ 0,A
2220 IF A<128 GOTO 2210
2230 IF A=236 GOTO 2300
2240 IF A=242 GOTO 2350
2250 IF A=230 GOTO 3000
2260 IF A=232 GOTO 2000
2270 GOTO 2210
2295 REM-LEFT TURN
2300 Z=Z-1
2310 IF Z<1 Z=Z+4
2320 GOTO 3050
2345 REM-RIGHT TURN
2350 Z=Z+1
2360 IF Z>4 Z=Z-4
2370 GOTO 3050
2395 REM-CLEAR SCREEN AND WAIT
2400 I=12
2410 VDU 0,I
2420 FOR I=1 TO 600
2430 NEXT I
2440 RETURN
2445 REM-RESET CURSOR AND WAIT
2450 I=28
2460 GOTO 2410
2495 REM-ERASE MESSAGE ROUTINE
2500 GOSUB 2860
2510 PRINT
2520 GOSUB 2450
2530 S=0
2540 RETURN
2595 REM-ROTATE AND LOOK ROUTINE
2600 IF B=0 GOTO 2710
2610 IF B>V E=2;RETURN
2620 F=@(A+(B-1)*H)
2630 IF Z=1 GOTO 2670
2635 REM-ROTATE
2640 FOR I=2 TO Z
2650 F=F/2+(F-(F/2)*2)*8
```



```
2660 NEXT I
2670 C=F-(F/2)*2
2680 D=F/4-(F/8)*2
2690 E=F/2-(F/4)*2
2700 RETURN
2705 REM-OUTSIDE MAZE
2710 C=0,D=0,E=-1
2720 IF Z#1 GOTO 2760
2730 E=1
2740 IF A=W E=0
2750 RETURN
2755 REM-NO MANS LAND
2760 IF Z=3 E=2
2770 IF Z=2 IF A=H E=2
2780 IF Z=4 IF A=1 E=2
2790 RETURN
2795 REM-INDEX TO NEXT CELL
2800 IF E>0 GOTO 2930
2810 IF Z=1 B=B+1
2820 IF Z=2 A=A+1
2830 IF Z=3 B=B-1
2840 IF Z=4 A=A-1
2850 RETURN
2855 REM-MESSAGE ROUTINE
2860 FOR I=1 TO 8
2870 PRINT 'J,
2880 NEXT I
2890 FOR I=1 TO 23
2900 PRINT 'I,
2910 NEXT I
2920 RETURN
2930 GOSUB 2860
2940 IF E=1 PRINT "   DEAD END   ",
2950 IF E=2 PRINT "NO MANS LAND",
2960 GOSUB 2450
2970 S=1
2980 RETURN
2995 REM-FORWARD ROUTINE
3000 A=X,B=Y
3010 GOSUB 2600
3020 GOSUB 2800
3030 X=A,Y=B
3040 IF E>0 GOTO 2200
3045 REM-3D DISPLAY ROUTINE
3050 A=X,B=Y
3060 GOSUB 2600
3065 REM-5 DEPTHS
3070 FOR T=1 TO 5
3080 GOSUB 3200
3085 REM-CHECK FOR NEXT DEPTH
3090 IF E#0 GOTO 2200
3100 GOSUB 2800
3110 GOSUB 2600
3120 IF E=2 GOTO 2200
```



```
3130 NEXT T
3140 GOTO 2200
3195 REM-JUMP TO DISPLAY DEPTH
3200 GOTO T*400+2310
3205 REM-DISPLAY DEPTH 1
3210 GOSUB 2400
3220 IF E<0 RETURN
3230 IF E>1 RETURN
3240 FOR I=80 TO 976 STEP 64
3250 VDU I,116
3260 VDU I+28,116
3270 NEXT I
3280 IF E=0 RETURN
3290 FOR I=81 TO 107
3300 VDU I,107
3310 VDU I+896,103
3320 NEXT I
3330 RETURN
3600 REM-DISPLAY DEPTH 2
3610 IF C=0 GOTO 3690
3620 VDU 81,114
3630 VDU 147,114
3640 VDU 213,114
3650 VDU 977,113
3660 VDU 915,113
3670 VDU 853,113
3680 GOTO 3730
3690 FOR I=273 TO 277
3700 VDU I,107
3710 VDU I+512,103
3720 NEXT I
3730 IF D=0 GOTO 3810
3740 VDU 107,113
3750 VDU 169,113
3760 VDU 231,113
3770 VDU 1003,114
3780 VDU 937,114
3790 VDU 871,114
3800 GOTO 3850
3810 FOR I=295 TO 299
3820 VDU I,107
3830 VDU I+512,103
3840 NEXT I
3850 FOR I=273 TO 790 STEP 64
3860 VDU I,116
3870 VDU I+16,116
3880 NEXT I
3890 IF E=0 RETURN
3900 FOR I=279 TO 293
3910 VDU I,107
3920 VDU I+512,103
3930 NEXT I
3940 RETURN
4000 REM-DISPLAY DEPTH 3
4010 IF C=0 GOTO 4070
4020 VDU 279,114
4030 VDU 345,114
4040 VDU 791,113
4050 VDU 723,113
4060 GOTO 4110
4070 FOR I=407 TO 409
4080 VDU I,107
4090 VDU I+256,103
4100 NEXT I
4110 IF D=0 GOTO 4170
4120 VDU 293,113
4130 VDU 355,113
4140 VDU 805,114
4150 VDU 739,114
4160 GOTO 4210
4170 FOR I=419 TO 421
4180 VDU I,107
4190 VDU I+256,103
4200 NEXT I
4210 FOR I=410 TO 666 STEP 64
4220 VDU I,116
4230 VDU I+8,116
4240 NEXT I
4250 IF E=0 RETURN
4260 FOR I=411 TO 417
4270 VDU I,107
4280 VDU I+256,103
4290 NEXT I
4300 RETURN
4400 REM-DISPLAY DEPTH 4
4410 IF C=0 GOTO 4450
4420 VDU 411,114
4430 VDU 667,113
4440 GOTO 4470
4450 VDU 475,107
4460 VDU 603,103
4470 IF D=0 GOTO 4510
4480 VDU 417,113
4490 VDU 673,114
4500 GOTO 4530
4510 VDU 481,107
4520 VDU 609,103
4530 FOR I=476 TO 604 STEP 64
4540 VDU I,116
4550 VDU I+4,116
4560 NEXT I
4570 IF E=0 RETURN
4580 FOR I=477 TO 479
4590 VDU I,107
4600 VDU I+128,103
4610 NEXT I
4620 RETURN
4800 REM-DISPLAY DEPTH 5
4810 IF C=0 GOTO 4850
4820 VDU 477,114
4830 VDU 605,113
4840 GOTO 4870
4850 VDU 477,103
4860 VDU 605,107
4870 IF D=0 GOTO 4910
4880 VDU 479,113
4890 VDU 607,114
4900 GOTO 4930
4910 VDU 479,103
4920 VDU 607,107
4930 VDU 541,106
4940 VDU 543,105
4950 IF E=0 RETURN
4960 VDU 478,103
4970 VDU 606,107
4980 RETURN
4995 REM-WAY OUT FOUND
5000 GOSUB 2400
5010 GOSUB 2860
5020 PRINT '  WAY OUT
5030 STOP
```

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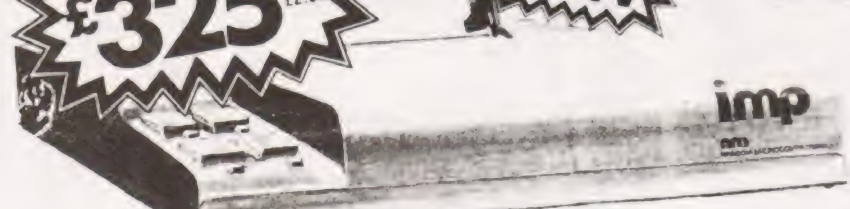

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HENRY'S
Computer Kit Division
404 Edgware Road, London, W2, England
01-402 6822

Dear Sir,

Having completed my first course in machine-code programming at University last year, I was very interested in any software concerned with the INTEL 8080 and to this extent I obtained a copy of the L5.1 Monitor/Tiny Basic for the TRITON. Going through the listing and understanding everything was the task I set myself and just recently completed. However, there are a few points I would like to bring up with the programmer.

1. The Random number Generator; this works by having a pointer increment for each call of RND, with the pointer set to the interpreter code. The BASIC interpreter resides in ROM between locations 0400 and 0CD4. The pointer is initially set to a value between 0400 & 04FF and then picks up Interpreter code, using this code as the random numbers. When the pointer reaches 0CD5 it is set to 0400 and repeats itself. In effect the whole Basic interpreter is treated as a table of random numbers. My objection is that not all the numbers are there, so that the table is not producing a set of linear random numbers. Also the series is rather predictable.

Some ideas to remedy this. The pointer is in two bytes at 14C7 which I think in decimal is 5319. So a program could start off 10 input A; poke 5319, A/2000 (A is any number — a seed). This will give a better spread of numbers, as the random number table can start in the MONITOR rather than the INTERPRETER.

2. In TAB2 (which is a look up table for statements), IF comes before INPUT. So if a program comes across I, this will be treated as IF. This means however that the short form of INPUT is IN. Now the short form of IN is the same length as IF (=I). So that should the positions of IF and INPUT be changed around, I. will represent INPUT and IF will still be 2 bytes long. The overall result being to save valuable bytes.

3. Other micro-computers define PEEK and POKE as single byte operators. For double length working, the commands DEEK and DOKE have been introduced. Now there are several applications where a single-length PEEK would be useful, On screen Editing and video games are two. Yet the only way to do this is to enter an m/c subroutine and call it. As there is already a single length POKE on the machine (VDU), could not a single length Peek be added?

4. A tip for those who are writing programs with BASIC and 8080 code combined. Have all the 8080 subroutines at the very top of memory compressed as tight as is possible. Now take the Start address of the lowest subroutine and put this into locations 1481 and 1482. This has the effect of limiting the memory for programs and array so that should an Array index go out of bounds because of a bug, then a SORRY message will appear but the subroutines will still be safe. The subroutine memory is "protected".

5. The spare functions SPRA, SPRB, SPRC and SPRD provide vectors to 1FFd, 1FFA, 1FF7 and 1FF4. But anyone with offboard RAM which goes past those addresses is going to have to avoid these functions as calling them will jump straight into the BASIC program and crash it more than likely. It would be advisable to vector them into an area near the interrupt vectors which were shifted themselves for the very same reasons.

The whole exercise I found very illuminating. Were I to write a BASIC (Tiny or otherwise), then the knowledge gained here would be invaluable. One thing I would prefer though: when a program is entered, if a number goes first, then any rubbish can be typed in. The validity of the lines is not checked until run-time. An alternative method is to search the line as it is entered, and if a statement is found (LET, GOTO, PRINT etc.) then substitute a special character for it. This has the further benefit of great savings in program storage. Execution is the same as before except that less searching for a match is needed, this speeds the running. Special characters can be obtained from using the codes 128-255. As these are never input or output, no formatting of the top bit is needed. Eg. Program listings print the characters GOTO when the code for goto is found. No confusion arises wiht the special characters and "numbers in Hex", as apart from the line number, all other numbers are stored in character form which is ASCII using only codes 0-127. A final bit of ingenuity is to make the special characters Indices in a jump table for the functions. The running time is then very quick.

Yours etc.
David Bolton.

19 Carrickburn Road,
Carrickfergus,
Co. Antrim.

Dear Sir,

Mini Ledger Program — August Issue CT

The criticisms of the hexadecimal listing of the above program on the pages which followed the BASIC program are fair comment and I admit to having fallen into one of the 'traps for the unwary'!. The criticism should, however, be levelled at me and not the editorial staff on this occasion. Each of the writers of the letters you printed were of course quite correct and I accept their statements as constructive and valid.

One of the great assets of CT is the facility it provides on the (printout) page for those like myself who are anxious and willing take advice and criticism from those more learned in the art of programming, and I am most grateful to all those who took the trouble to write.

Yours sincerely,
W.H. Davies.

98 Henley Road,
Cheltenham,
Glos. GL51 0LD.

Dear Sir,

The November edition of CT contained a letter from Nick Beard suggesting that the Hangman program from the Sept issue could be improved by use of an ON. .GOTO statement in line 475. It appears to me that lines 480 to 730 could be replaced by the one line :

480 M=(ASC(Y$)–65)*2–54*(Y$>"M"):IF M>10 40RM<0 THEN PRINT "LETTERS ONLY":GOTO220

Where the Y$>"M" expression yields a value of –1 only if true. I feel that a magazine like CT which runs articles claiming to teach good programming techniques should think twice before publishing programs of such poor style.

Yours sincerely
Ray Bannon.

8 Carmarthen Close,
Hinsford,
Cheshire.

Dear Sir,

I found your Triton typecast article very interesting since many years ago, I was a foreman of signals, in the army, responsible for the maintenance of many such machines. I have also recently bought a WD. 7B machine which will be used with a computer I am making and will be adapting parts of the program for use with it (it will use a Z80).

However, some additional information, to that given in the article seems to be necessary, if any user is to get long and satisfactory operation of such machines.

No mention is made that a current limiting resistor is necessary in the 24 V supply to ther operating magnet. The operating current of this when used in the single current mode as shown, must be at least 30 mA, but cannot be very much more, otherwise the coils will burn out. The resistance of each coil is nominally 100R, hence with both in series a limiting resistor of about 600R is needed, I use 560R which gives satisfactory operation.

With the standard connections to the 9 pin plug, shown in the creed manual, the junction between the two magnet coils goes to pin 2, hence I think that with the connections shown in the article, only one coil is in use. To use both in series as usual for single current operation the ground connection should go to pin 3.

Most teleprinters with 24 V DC motors on the surplus market are ex-WD machines. The GPO machines usually have 240 V AC motors. My own machine is ex WD and its electrical connections are standard army as shown on the attached photocopies, except that the 2u capacitor connected to terminal 4 of the RH strip, and the 500n and 300R connected to terminal 7 are missing. (Note that the plug pin numbering is reversed as compared with your article).

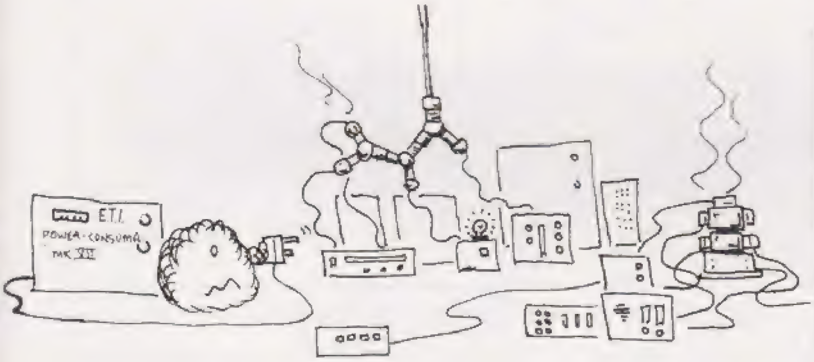
For satisfactory operation in the single current mode, the creed manual shows the missing 2u capacitor connected across the magnet coils, and I have found this necessary and added it. (The 500n + 300R is used instead in the double current mode). The creed manual (see copies of Pp26, 27 attached) also gives other conditions for single current operation, including a 50 V signalling supply, but the army never used this and I have not found it necessary.

The DC motor requires 3 A when running, with a much higher starting current. I use the circuit shown below. (The army used a circuit in which single phase input was converted to 3-phase at 120° and rectified this).

It is stated in the article that "they use cheap roll type paper rather than continuous forms". This is incorrect machines with friction feed and machines with sprocket feed are both available. My machine is a sprocket feed with a carriage for a pack of forms, but I have adapted it for friction feed. It had no missing parts, all the adjustments were correct and it worked adequately after oiling.

Yours faithfully,
W.H. Hammond.

6 Meadow Road,
Gravesend,
Kent DA11 7LR.



Dear Sir,

The letter in 'Printout' in CT dated November '79 must have been written by an idiot. Anyone can see that the improvement to M'J'Coates' "Hangman" program should be:

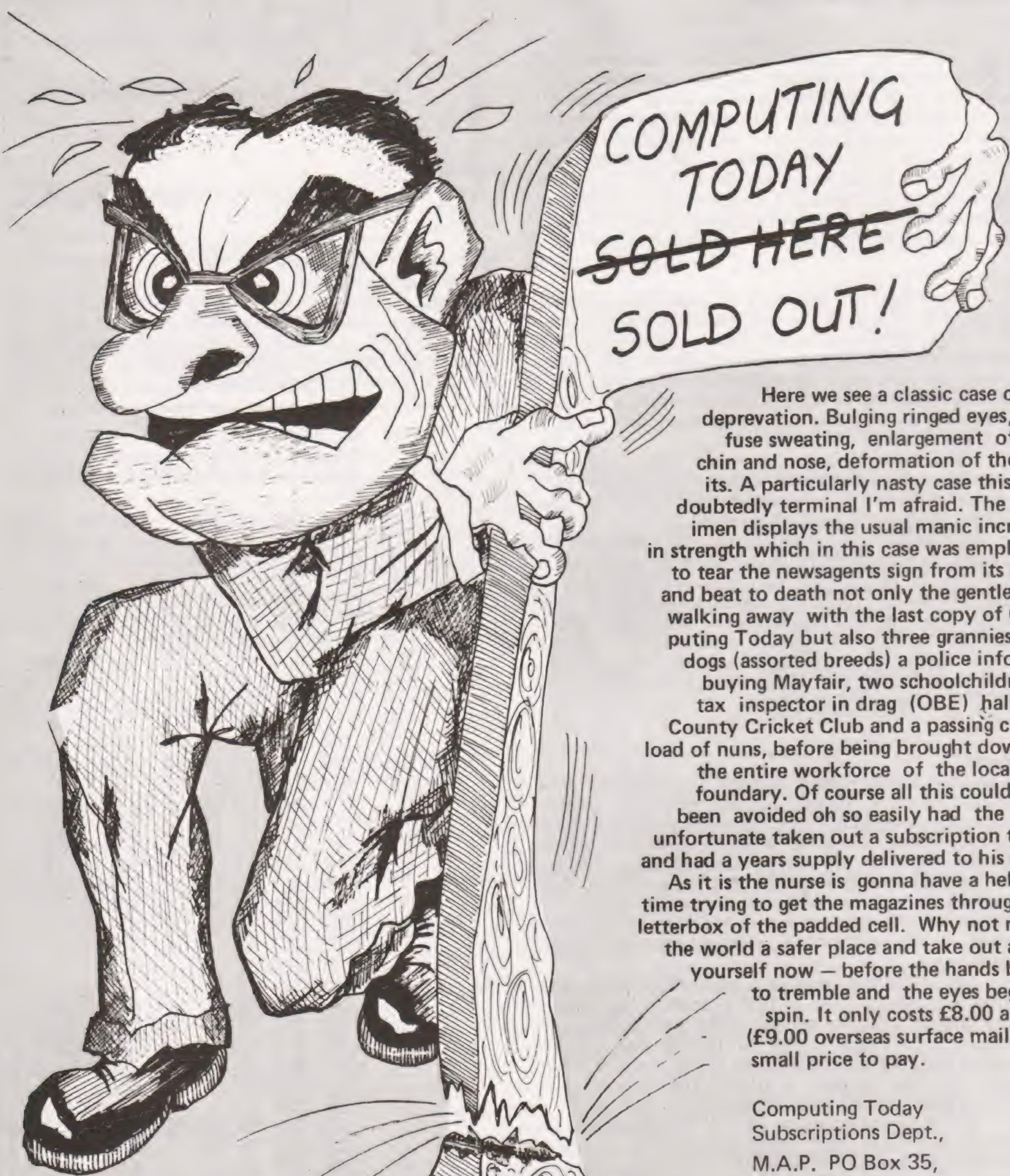
```
475 ON (ASC(Y$)—30) GOTO 480,490,500......730
480 M=0
485 GOTO 740
490 M=2
495 GOTO 740
500
505
—
—
725 GOTO 740
730 M=104
```

What an idiot. That'll teach him to submit untested programs!

Nick Beard.

St.George's Hospital,
Medical School,
Cranmer Terrace,
London SW17 0RE.

ARRRGGGHHH.....



Here we see a classic case of CT deprivation. Bulging ringed eyes, profuse sweating, enlargement of the chin and nose, deformation of the digits. A particularly nasty case this. Undoubtedly terminal I'm afraid. The specimen displays the usual manic increase in strength which in this case was employed to tear the newsagents sign from its roots and beat to death not only the gentleman walking away with the last copy of Computing Today but also three grannies, five dogs (assorted breeds) a police informer buying Mayfair, two schoolchildren, a tax inspector in drag (OBE) half the County Cricket Club and a passing coach load of nuns, before being brought down by the entire workforce of the local iron foundary. Of course all this could have been avoided oh so easily had the poor unfortunate taken out a subscription to CT and had a years supply delivered to his door. As it is the nurse is gonna have a hell of a time trying to get the magazines through the letterbox of the padded cell. Why not make the world a safer place and take out a sub yourself now — before the hands begin to tremble and the eyes begin to spin. It only costs £8.00 a year (£9.00 overseas surface mail) — a small price to pay.

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M.A.P. PO Box 35,
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Hertfordshire.

T.P. Goldingham

Let your micro run your slide shows for you with this Nascom package

Do you own a remote-controlled slide projector? Would you like to be able to operate it automatically, so as to provide a non-stop slide display without the need for a human operator? The NASCOM program described below was developed for a wedding reception, where a 'This Was Your Life' series of photographs of the bride was on show to the guests throughout the afternoon in a room adjacent to the reception. The program would be equally suitable for advertising or training material, or for any situation where continuous projection is required.

Hardware

The projector used was a Rollei P-35, which has a straight magazine and a remote control unit with a single slide change button. A short pressure moves the magazine forward, a longer pressure moves it back. The NASCOM program moves the magazine forward at regular intervals until all the slides have been projected, then reverses the movement and works back through the magazine to the beginning. This process is repeated indefinitely.

The program would control any similar projector: for one with a circular magazine, such as the Kodak Carousel, no backward movement would be necessary (in which case lines 80 – 85 should be modified to zeros).

My NASCOM 1 had been fitted with a relay to control a cassette recorder (a circuit diagram of the modification was given in the April 79 and May 79 issues of COMPUTING TODAY. However, I found that the current used by the slide projector was sufficient to cause arcing at the relay which occasionally broke the program. I overcame this by passing the slide control current through a separate relay, and controlling the operating coil of that relay by the relay in the NASCOM, as shown in Figure 1.

Software

The program comprises three sections. The first section displays instructions to the operator, and reads in the number of slide changes required. The core of the program consists of two loops, one controlling the length of the slide change pulse and the other the interval between pulses. Finally, there is provision to interrupt the loop at any time to stop and restart the program. While the program is stopped the magazine can of course be moved backward and forward manually at will, provided it is returned to the point where it was stopped.

Let us look at these sections in more detail. The program is executed from its first instruction, and begins with a program reference number, which can be deleted if desired. It then jumps to the INITIALISE VARIABLES section at line 147, which for greater clarity is placed immediately after the variables it affects. The program then returns to DISPLAY INSTRUCTIONS.

In the preamble, several lines of message appear on the screen (see Figure 2). To make these easier to assimilate, when they are first shown the display is deliberately slowed down by calling the delay subroutine (lines 157 – 159). However, when the main loop is started by typing S, this delay is eliminated by the routine in lines 168 – 171, so that

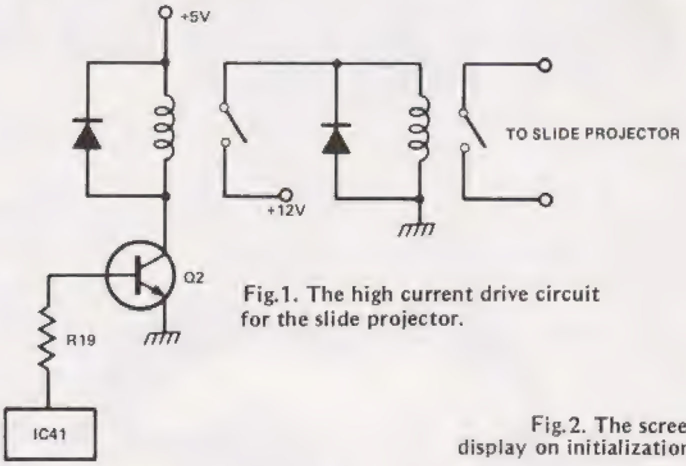

Fig.1. The high current drive circuit for the slide projector.

Fig.2. The screen display on initialization.

if the program is restarted the now familiar messages are displayed instantaneously.

The preamble includes a check (lines 173 – 185) against letters being accidentally keyed in instead of numerals. However, it is possible for the wrong number to be typed, so the facility is provided to return to the monitor (by typing M) and restart the program.

PREAMBLE
Displays introductory messages,
accepts number of slides from keyboard

```
 1 D00 EF 1E        RST40
 2 D03 39 38 31 32  9 8 1 2

 3 D04 00
 4 D07 C3 70 0E
DISPLAY INSTRUCTIONS
 5 D0A 11 D2 0B     LD DE, 0BD2
 6 D0D 21 FF 0E     LD HL, 0EFF
 7 D10 CD A0 0E     CALL DISPLAY
 8 D13 11 CD 08     LD DE, 08CD
 9 D16 21 19 0F     LD HL, 0F19
10 D19 CD A0 0E     CALL DISPLAY
ACCEPT NO. OF SLIDES
11 D1C CD 69 00     CALL KBD
12 D1F 30 FB        JRNC –3
13 D21 11 F1 08     LD DE, 08F1
14 D24 12           LD (DE), A
15 D25 CD C0 0E     CALL NUMCHECK
16 D28 E6 0F        AND OF
17 D2A 28 09        JR +11
18 D2C 47           LD B, A
19 D2D AF           XOR A
20 D2E C6 0A        ADD 10
21 D30 10 FC        DJNZ –2
22 D32 32 60 0E     LD 0E60, A
23 D35 CD 69 00     CALL KBD
24 D38 30 FB        JR –3
25 D3A 11 F2 08     LD DE, 08F2
26 D3D 12           LD (DE), A
27 D3E CD C0 0E     CALL NUMCHECK
28 D41 E6 0F        AND OF
29 D43 47           LD B, A
30 D44 3A 60 0E     LD A, 0E60
31 D47 80           ADD B
32 D48 3D           DEC A
```

PROJECTOR CONTROLLER

```
*SLIDE PROJECTOR CONTROL*

Type number of slides (two digits): 25

Position magazine so that first slide shows

Switch to REMOTE

Type S to start


(To return to monitor type M)
```

The duration of the slide change pulse is controlled by a simple delay loop (lines 55 – 59). The duration of the pulse is controlled by a count, which is doubled when the end of the magazine is reached so as to provide for the necessary succession of backward changes (lines 80 – 86). This count is held in E7B – line 151 – and can be modified if necessary to suit the projector being used.

The viewing time loop is in fact two loops, one inside the other. The inner one is controlled by the count at D9B–C (line 64) to last for approximately one second. The number of times this loop is gone round depends on the count at E65 (line 143) which may be modified to any desired value.

Within the inner loop is a jump at line 68 to a routine which checks the keyboard for a STOP instruction. This may be 'H', meaning 'Halt immediately', in which case lines 98–99 loop around until the program is restarted by 'S'; alternatively, there may be an instruction 'E' to stop when the last slide has been shown. In this case a marker is set (tested at lines 77–78).

Note that any unused locations in the program are filled with 'E7'. This procedure, as recommended in the NASCOM Newsletter, ensures that should the program reach one of these locations owing to a program fault, it will return to monitor and display diagnostic information rather than wander off into a loop.

Possible Enhancements

Users with extended store should find it a fairly simple matter to display a caption to coincide with each slide. A further refinement would be to set up a table with a different viewing time for each slide.

```
Clear screen
(This is a program reference
number which may be reset to
zeros if desired).

Jump to INITIALISE VARIABLES

Point at screen
Point to message
Display '*SLIDE CONTROL III*'
Point to screen
Point to message
Display 'Type number . . .'

Call S/R to examine keyboard
Jump back if no key
Point at screen
Display first digit
Call S/R to check for numeric key
Mask off first 4 bits
Jump on if = 0
Put first digit in B
Clear A
Add 10
Jump back till zero
Transfer tens to slidecount
Call S/R to examine keyboard
Jump back if no key
Point at next space
Print second digit
Call S/R to check for numeric key
Mask off first 4 bits
Put second digit in B
Bring back part count to A
Add units to tens
Subtract 1 to give number of changes
```

```
 33  D49  32 60 0E   LD 0E60, A      Transfer to CHANGECOUNT
DISPLAY INSTRUCTIONS 2
 34  D4C  11 4D 09   LD DE, 094D     Point at screen
 35  D4F  CD A0 0E   CALL DISPLAY    Display 'Position magazine . . .'
 36  D52  11 CD 09   LD DE, 09CD     Point at screen
 37  D55  CD A0 0E   CALL DISPLAY    Display 'Switch to REMOTE'
 38  D58  11 4D 0A   LD DE, 0A4D     Point at screen
 39  D5B  CD A0 0E   CALL DISPLAY    Display 'Type S to start'
 40  D5E  11 4D 0B   LD DE, 0B4D     Point at screen
 41  D61  CD A0 0E   CALL DISPLAY    Display 'To return . . .'
 42  D64  CD 69 00   CALL KBD        Call S/R to examine keyboard
 43  D67  FE 4D      CP M            Is it M?
 44  D69  CA 00 00   JPZ 0000        Return to monitor if M
 45  D6C  FE 53      CP S            Is it S?
 46  D6E  20 F4      JR -10          Jump back if not S
START
 47  D70  C3 B0 0E   JP 0EB0         Jump to MODIFY DISPLAY
 48  D73  11 CD 08   LD DE, 08CD     Point at screen
 49  D76  CD A0 0E   CALL DISPLAY    Display 'Type H . . .'
 50  D79  11 4D 09   LD DE, 094D     Point at screen
 51  D7C  CD A0 0E   CALL DISPLAY    Display 'Type E . . .'
 52  D7F  00         NOP
 53  D80  3A 60 0E   LD A, 0E60      ) Place changecount
 54  D83  4F         LD C,A          )    in C

SLIDE CHANGE LOOP
Provides set number of change pulses at required intervals
SLIDE CHANGE
 55  D84  3A 62 0E   LD A, 0E62      ) Place shortcount
 56  D87  47         LD B, A         )    in B
 57  D88  CD 51 00   CALL MOTFLP     Call S/R to switch relay on
 58  D8B  CD 35 00   CALL KDEL       Call S/R to delay for 7.5 mS
 59  D8E  10 FB      DJNZ -3         Jump back till B is zero
VIEWING TIME
 60  D90  3A 65 0E   LD A, 0E65      ) Place viewtime
 61  D93  47         LD B, A         )    in B
 62  D94  11 FF FF   LD DE, -1       Store constant of -1 in DE
 63  D97  CD 51 00   CALL MOTFLP     Call S/R to switch relay off
 64  D9A  21 FF 02   LD HL, 2FFH     Store count in HL
 65  D9D  19         ADD HL, DE      Subtract 1 from count (by adding
                                     -1)
```

```
 66  D9E  08            EX              )Exchange registers to preserve
 67  D9F  D9            EXX             ) while jumping out to
                                        KEYBOARD.
 68  DA0  18  28        JR +42          Jump to KEYBOARD
 69  DA2  08            EX              ) Restore registers
 70  DA3  D9            EXX             )
 71  DA4  38  F7        JRC -7          Jump back till HL is zero
 72  DA6  10  F2        DJNZ -12        Jump back till B is zero
 73  DA8  79            LD A, C         )
 74  DA9  CE  FF        ADDC FFH        ) Subtract 1 from
 75  DAB  4F            LD C, A         ) CHANGECOUNT
 76  DAC  20  D6        JRNZ -40        Jump back to SLIDE CHANGE
                                        until all slides seen.
```

TEST MARKER

```
 77  DAE  3A  61  0E    LD A, 0E61      ) Test marker
 78  DB1  B7            0R              ) (set by E)
 79  DB2  C2  00  00    JPNZ 0000       Return to monitor if marker set
```

CHANGEOVER

Changes length of pulse to provide alternate forward and backward movement

```
 80  DB5  3A  62  0E    LD A, 0E62      ) Move SHORTCOUNT to
 81  DB8  32  64  0E    LD 0E64, A      ) CHANGEOVER
 82  DBB  3A  63  0E    LD A, 0E63      ) Move DOUBLECOUNT to
 83  DBE  32  62  0E    LD 0E62, A      ) SHORTCOUNT
 84  DC1  3A  64  0E    LD A, 0E64      ) Move CHANGEOVER to
 85  DC4  32  63  0E    LD 0E63, A      ) DOUBLECOUNT
 86  DC7  C3  80  0D    JP 0D80         Return to start of magazine
```

KEYBOARD

Accepts letters typed on the keyboard and initiates appropriate action

```
 87  DCA  CD  69  00    CALL KBD        Calls S/R to examine keyboard
 88  DCD  30  D3        JPNC -43        If no key, return to line 69
 H
 89  DCF  FE  48        CP H            Is it H?
 90  DD1  20  3D        JRNZ +63        If not H, jump on to E
 91  DD3  EF  1E  48    41 RST40 H A    Clear screen. Display message
 92  DD7  4C  54  45    44 L T E D
 93  DDB  2E  20  54    79 . - T y
 94  DDF  70  65  20    53 p e - S
 95  DE3  20  74  6F    20 - t o -
 96  DE7  73  74  61    72 s t a r
 97  DEB  74  00           t @
 98  DED  CD  69  00    CALL KBD        Call S/R to examine keyboard
 99  DF0  FE  53        CP S            Is it S?
100  DF2  20  F9        JRNZ -5         Jump back until S is typed
101  DF4  EF  1E  00    RST40           Clear screen
102  DF7  3A  61  0E    LD A, 0E61      )
103  DFA  B7            0R              ) Test marker
104  DFB  20  1E        JRNZ +32        If marker, set jump on to line 118
105  DFD  00            N0P
106  DFE  11  CD  08    LD DE, 08CD     Point at screen
107  E01  21  A8  0F    LD HL, 0FA8     Point to message
108  E04  CD  A0  0E    CALL DISPLAY    Display 'Type H . . .'
109  E07  11  4D  09    LD DE, 094D     Point at screen
110  E0A  CD  A0  0E    CALL DISPLAY    Display 'Type E . . .'
111  E0D  C3  A2  0D    JP 0DA2         Return to line 69
E
112  E10  FE  45        CP E            Is it E?
113  E12  20  32        JNZ +52         If not E, jump on to M
114  E14  3E  01        LD A, 1         ) Set marker to stop at
115  E16  32  61  0E    LD 0E61, A      ) end of magazine.
116  E19  81            ADD C           ) Add 1 to
117  E1A  4F            LD C, A         ) changecount.
118  E1B  EF  1E  20    53 RST40 - S
119  E1F  54  4F  50    50 T O P P
120  E23  49  4E  47    20 I N G -
121  E27  41  54  20    45 A T - E
122  E2B  4E  44  20    4F N D - O
123  E2F  46  20  4D    41 F - M A
124  E33  47  41  5A    49 G A Z I
125  E37  4E  45  00       N E @
126  E3A  11  CD  08    LD DE, 08CD
127  E3D  21  A8  0F    LD HL, 0FA8
128  E40  CD  A0  0E    CALL DISPLAY
129  E43  C3  A2  0D    JP 0DA2
M
130  E46  FE  4D        CP M
131  E48  CA  00  00    JPZ 0000
```

OTHER KEY

```
132  E4B  EF  57  52    4F RST40 W R 0
133  E4F  4E  47  20    4B N G - K
134  E53  45  59  20    20 E Y - -
135  E57  20  20  00       - - @
136  E5A  C3  CA  0D    JP 0DCA
137  E5D  E7  E7  E7    RST RST RST
```

VARIABLES

```
138  E60  xx            CHANGECOUNT
139  E61  xx            MARKER
140  E62  30            SHORTCOUNT

141  E63  xx            DOUBLECOUNT

142  E64  xx            CHANGEOVER

143  E65  08            VIEWTIME

144  E66  E7  E7  E7  E7 RST
145  E6A  E7  E7  E7  E7
146  E6E  E7  E7
```

INITIALISE VARIABLES

Sets the above variables at the start of the program

```
147  E70  AF            X0R A
148  E71  32  60  0E    LD 0E60, A
149  E74  32  61  0E    LD 0E61, A
150  E77  32  64  0E    LD 0E64, A
151  E7A  3E  30        LD A, 30
152  E7C  32  62  0E    LD 0E62, A
153  E7F  87            ADD A, A
154  E80  32  63  0E    LD 0E63, A
155  E83  C3  0A  0D    JP 0D0A

156  E86  E7 . . .      RST
```

DISPLAY

```
157  E97  CD  35  00    CALL KDEL
158  E9A  CD  35  00    CALL KDEL
```

Clear screen. Display message

Point at screen
Point to message
Display 'Type H . . .'
Return to line 69

Is it M?
If M, return to monitor

Display message

Jump to KEYBOARD
(Breakpoint — spare locations)

Number of slide changes
Set to stop at end of magazine
Length of forward slide change pulse.
Length of backward slide change pulse.
Used to exchange long and short pulses.
Time for which each slide is displayed.
(Breakpoint — spare locations)

Clear A
Clear CHANGECOUNT
Clear MARKER
Clear CHANGECOUNT
Set pulse length in A
and store in SHORTCOUNT.
Double pulse length count
Store in DOUBLECOUNT
Jump back to DISPLAY INSTRUCTIONS.
(Breakpoint — spare loactions)
NOTE: the value of E7B can be changed to provide pulses of suitable length for the projector being used. E65 can be changed to vary the time for which each slide is displayed.

These delays are incorporated to slow down the rate at which characters appear on the screen for the first time.

```
159  E9D  CD 35 00    CALL KDEL
160  EA0  23          INC HL          Point to next character
161  EA1  7E          LD A, (HL)      Pick up next character
162  EA2  FE 00       CP O            Is it O?
163  EA4  C8          RETZ            If so, return
164  EA5  12          LD DE, A        Display character
165  EA6  13          INC DE          Point to next screen position
166  EA7  18 EE       JR -16          Jump back to DISPLAY (NB:
                                      Jump is changed by next S/R.
167  EA9  E7 . . .    RST             (Breakpoint — spare locations)

MODIFY DISPLAY
168  EB0  3E F7       LD A, F7        Load new jump displacement
169  EB2  32 A8 0E    LD 0EA8, A      Modify jump instruction (line 166)
170  EB5  EF 1E 00    RST40           Clear screen
171  EB8  C3 73 0D    JP 0D73         Return to line 48
172  EBB  E7 . . .    RST             (Breakpoint — spare locations)

CHECK NUMERIC
173  EC0  FE 39       CP 39           Is character alphabetic?
174  EC2  D8          RETC            Return if numeric
175  EC3  EF 4E 55 4D RST40 N U M     Display message
176  EC7  45 52 41 4C E R A L
177  ECB  53 20 4F 4E S - O N
178  ECF  4C 59 2C 20 L Y , -
179  ED3  50 4C 45 41 P L E A
180  ED7  53 45 20 20 S E - -
181  EDB  20 00       - @
182  EDD  F1          LD AF, (SP)     Pop to decrement stack pointer
183  EDE  21 13 0D    LD HL, 0D13     Put return address in HL
184  EE1  E5          LD (S), HL      Push return address onto stack
185  EE2  C9          RET             Return
186  EE3  E7 . . .    RST             (Breakpoint — spare locations)

MESSAGES
187  F00  2A 53 4C 49 44 45 20 50   * S L I D E - P
188  F08  52 4F 4A 45 43 54 4F 52   R O J E C T O R
189  F10  20 43 4F 4E 54 52 4F 4C   - C O N T R O L
190  F18  2A 00 54 79 70 65 20 6E   * @ T y p e - n
191  F20  75 6D 62 65 72 20 6F 66   u m b e r - o f
192  F28  20 73 6C 69 64 65 73 20   - s l i d e s -
193  F30  28 74 77 6F 20 64 69 67   ( t w o - d i g
194  F38  69 74 73 29 3A 00 50 6F   i t s ) : @ P o
195  F40  73 69 74 69 6F 6E 20 6D   s i t i o n - m
196  F48  61 67 61 7A 69 6E 65 20   a g a z i n e -
197  F50  73 6F 20 74 68 61 74 20   s o - t h a t -
198  F58  66 69 72 73 74 20 73 6C   f i r s t - s l
199  F60  69 64 65 20 73 68 6F 77   i d e - s h o w
200  F68  73 00 53 77 69 74 63 68   s @ S w i t c h
201  F70  20 74 6F 20 52 45 4D 4F   - t o - R E M O
202  F78  54 45 00 54 79 70 65 20   T E @ T y p e -
203  F80  53 20 74 6F 20 73 74 61   S - t o - s t a
204  F88  72 74 00 28 54 6F 20 72   r t @ ( T o - r
205  F90  65 74 75 72 6E 20 74 6F   e t u r n - t o
206  F98  20 6D 6F 6E 69 74 6F 72   - m o n i t o r
207  FA0  20 74 79 70 65 20 4D 29   - t y p e - M )
208  FA8  00 54 79 70 65 20 48 20   @ T y p e - H -
209  FB0  74 6F 20 68 61 6C 74 00   t o - h a l t @
210  FB8  54 79 70 65 20 45 20 74   T y p e - E - t
211  FC0  6F 20 73 74 6F 70 20 61   o - s t o p - a
212  FC8  74 20 65 6E 64 20 6F 66   t - e n d - o f
213  FD0  20 6D 61 67 61 7A 69 6E   - m a g a z i n
214  FD8  65 00 E7 E7 E7 E7 E7 E7   e @(B r e a k p o i n t)
```

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SC/MP ADDRESSING

Some interesting quirks of SC/MP programming that make life easier

One of the more useful – and unusual – methods of addressing in the SC/MP microprocessor is the ability to operate memory reference instructions on a data-relative basis. As an example, when maintaining a multiple seven segment display in software, it is convenient to keep a look-up table of display patterns. If the number 5, for example, were required to be displayed, then the pattern represented by the hex byte 6D would be sent to the display.

Obtaining this type of information from a table is normally done in an indexed mode of operation, using one of the pointers. The simplest way is as shown in program 1, but this requires that the table starts at XX00 (Hex). For a table located anywhere in memory, program 2 could be used. (Note all programs assume that any registers required for other working have already been saved on stack; the contents of A are also lost!)

Program 3 gives the solution using the Extension-relative mode of operation where the data is fetched or stored at a location relative to the contents of the E register. Using this method the table can be placed in the logical position, that is, at the end of the program or sub-routine which requires the table. The only limitation is that the table may not be more than 127 bytes above the LD – E – REL instruction.

Conditional Jumps

There are occasions in a program when several decisions have to be made and sub-routines or jumps performed according to the value of specific data. Where the data is of a sequential nature and the sub-routines can be contained between xx00 and xxFF locations, program 4 can be used.

An example is entering a control letter A to F from a hexadecimal keyboard, the control letter being used to determine which sub-routine to use (E for Examine, F for File, C for Cancel, etc.) It is again assumed that any register contents required for later use have been saved, and that data fetched is transferred to the program counter, thus effecting a jump.

Should a true sub-routine be required, with a return to the main program, then program 5 can accomplish this. It is assumed that P3 HI has already been set.

Where it is required to increment or decrement a pointer by a variable amount, the instruction LD @ EREL PTR can be used, where the displacement is again contained in E. Again, the contents of A are destroyed. However, if the data is required to be fetched from a decremented location, then this is accomplished by this one instruction, since the pointer is decremented before data is fetched, as normal. For the incremented case, the data has to be fetched by a separate LD instruction, as the pointer is incremented after data has been fetched from the current location.

Fetching Double-Byte Data

When fetching double-byte data, as, for example, in loading a sub-routine address which could be any location in memory, the table can be arranged for easiest access in one of the following ways. The shortest and simplest, program-wise, is program 6, where the table contains all the high addresses in the first part of the table, and all the low addresses in the second half (or vice versa). The drawback with the program is that the number of addresses have to be known when writing the program in order to set the pointer increment value and to assign the table values correctly. Where the table is to be added to at later times, then program 7 allows for a table length of up to 128 double bytes. Program 6, on the other hand, can handle a table of over 200 double bytes, and can be adapted to extend to almost any number of byte lengths.

(Note that the instruction ORE is used to add data to displacement rather than ADE. This saves setting or altering the carry/link bit).

Program 1 : Data is in A ; Table at XX00

```
        XPAL   P1              DATA BECOMES P1 L0
        LDI                    P1 HI
        XPAH   P1              P1 CONTAINS TABLE START ADDRESS
        LD     P1              FETCH PATTERN
```

Program 2 : Data is in A ; Table anywhere in memory

```
        ST     -1 P2           SET COUNTER ON STACK
        LD1
        XPAH   P1              SET P1 TO TABLE START ADDRESS (-1)
        LD1
        XPAL   P1
ADJUST  LD     @+1 P1          INCR TABLE PTR
        DLD    -1 P2           DECR COUNTER
        JNZ     ADJUST         IF COUNTER NOT ZERO, LOOP
        LD     P1              FETCH PATTERN
```

Program 3 : Data is in A ; Table at end of S/R

```
02      CCL                    ADD DISPLACEMENT FOR TABLE
F4XX    ADI                    START ADDRESS (COUNTED FROM LD INSTRUCTION)
01      XAE                    SET DISPLACEMENT VALUE IN E
C080    LD      E-REL          FETCH PATTERN
```

Program 4 : Data is in A ; Table at end of S/R

```
02      CCL                    ADD DISPLACEMENT FOR TABLE
F4XX    ADI                    START ADDRESS
01      XAE                    DISPLACEMENT TO E
C080    LD      E-REL          FETCH S/R ADDRESS L0 (-1)
30      XPAL    P.C.           CHANGE PROGRAM COUNTER
```

Program 5 : Data is in A ; Table at end of S/R

```
02      CCL                    ADD DISPLACEMENT
F4XX    ADI
01      XAE                    SET IN E
C080    LD      E-REL          FETCH ADDRESS L0
33      XPAL    P3             SET S/R PTR (L0)
3F      XPPC    P3             GO TO S/R
```

Program 6 : Data is in A ; P1 is assumed set to table location 00
Program is set to address 16 double bytes

```
01      XAE                    SET DISPLACEMENT
C180    LD      E-REL P1       FETCH FIRST BYTE
37      XPAH    P3             SET P3 HI WITH FIRST DATA
C510    LD      @+'10 P1       INCREMENT PTR TO SECOND HALF TABLE
C180    LD      E-REL P1       FETCH SECOND BYTE
33      XPAL    P3             SET P3 L0
3F      XPPC    P3             GO TO S/R
```

Program 7 : Data is in A ; P1 is assumed set to table location 00
Hi & Lo data are sequential in table

```
1E      RR
1E      RR
1E      RR                     EQUIVALENT TO SHIFT LEFT ONE
1E      RR
1E      RR                     EQUATES TO 'MULTIPLY BY 2'
1E      RR
1E      RR
01      XAE
C180    LD      E-REL P1       FETCH FIRST BYTE
37      XPAH    P3             LOAD TO P3 HI
C401    LDI                    INCREMENT DISPLACEMENT TO SECOND BYTE
58      ORE
01      XAE
C180    LD      E-REL P1       FETCH SECOND BYTE
33      XPAL    P3             LOAD TO P3 L0
3F      XPPC    P3             GO TO S/R
```

Mr. J.C. May.

CALENDAR CALCULATOR

The following program was inspired by Mr. Hiscroft's calendar program (see CT August). The program uses an algorithm based on the following knowledge. Most people know that a leap year is divisible by four, however it is also true that a leap year that starts on a Monday will be 28 years away from the next leap year starting on a Monday, the same is true for the other days of the week. Thus if the year is divided by 28 the remainder will indicate which day of the week the year starts on.

The form of the calendar presented is often called a 'Year Planner' and was originally designed for a college open day. Each date is preceded by a colon ':', except for Sunday which is preceded by an asterisk.

As the program was written on an EDUSystem 50 BASIC it has some points to note if you wish to use it on other systems. Since the language was a compiler if in an IF. . .THEN statement the condition is false the next statement is executed and not the next line. Also strings are limited to six characters, hence the broken up DATA statements. The program was designed to output to a lineprinter, hence the LPRINT statements and line 95 which centralises the printout.

The program has some limitations. It is only valid for dates in Gregorian form and does not account for the 11 days lost in September 1752. However within these restrictions it will calculate calendars between 32768 BC and 32767 AD.

THE PROGRAM LISTING

```
  5 FORA=1TO15\LPRINT" "\NEXTA
 10FORM=1TO3
 20 READA1$,A2$,A,B1$,B2$,B,C1$,C2$,C,D1$,D2$,D
 25LPRINT" "
 30 LPRINTA1$,A2$,B1$,B2$,C1$,C2$,D1$,D2$
 40FOR E = 1 TO 31
 50IFE>ATHEN 52\GOSUB200\GOTO60
 52 LPRINT" ",
 60IFE>BTHEN62\GOSUB200\GOTO70
 62 LPRINT" ",
 70IF E>CTHEN72\GOSUB 200\GOTO80
 72LPRINT" ",
 80 IFE>DTHEN82\GOSUB200\GOTO90
 82 LPRINT" ",
 90LPRINT" "\NEXTE
 95 FORS=1TO33\LPRINT\NEXTS
100NEXTM\GOTO2046
200 LPRINT":"E,\RETURN
1000 DATA"JANUAR","Y",31,"FEBRUA","RY",29,"MARCH","",31
1001DATA"APRIL","",30,"MAY","",31,"JUNE","",30,"JULY","",31
1002DATA"AUGUST","",31,"SEPTEM","BER",30,"OCTOBE","R",31
1003DATA"NOVEMB","ER",30,"DECEMB","ER",31
2046 END
```

1979 MAY	1979 JUNE	1979 JULY	1979 AUGUST
: 1	: 1	* 1	: 1
: 2	: 2	: 2	: 2
: 3	* 3	: 3	: 3
: 4	: 4	: 4	: 4
: 5	: 5	: 5	* 5
* 6	: 6	: 6	: 6
: 7	: 7	: 7	: 7
: 8	: 8	* 8	: 8
: 9	: 9	: 9	: 9
: 10	* 10	: 10	: 10
: 11	: 11	: 11	: 11
: 12	: 12	: 12	* 12
* 13	: 13	: 13	: 13
: 14	: 14	: 14	: 14
: 15	: 15	* 15	: 15
: 16	: 16	: 16	: 16
: 17	* 17	: 17	: 17
: 18	: 18	: 18	: 18
: 19	: 19	: 19	* 19
* 20	: 20	: 20	: 20
: 21	: 21	: 21	: 21
: 22	: 22	* 22	: 22
: 23	: 23	: 23	: 23
: 24	* 24	: 24	: 24
: 25	: 25	: 25	: 25
: 26	: 26	: 26	* 26
* 27	: 27	: 27	: 27
: 28	: 28	: 28	: 28
: 29	: 29	* 29	: 29
: 30	: 30	: 30	: 30
: 31	:	: 31	: 31

1979 JANUARY	1979 FEBRUARY	1979 MARCH	1979 APRIL
: 1	: 1	: 1	* 1
: 2	: 2	: 2	: 2
: 3	: 3	: 3	: 3
: 4	* 4	* 4	: 4
: 5	: 5	: 5	: 5
: 6	: 6	: 6	: 6
* 7	: 7	: 7	: 7
: 8	: 8	: 8	* 8
: 9	: 9	: 9	: 9
: 10	: 10	: 10	: 10
: 11	* 11	* 11	: 11
: 12	: 12	: 12	: 12
: 13	: 13	: 13	: 13
* 14	: 14	: 14	: 14
: 15	: 15	: 15	* 15
: 16	: 16	: 16	: 16
: 17	: 17	: 17	: 17
: 18	* 18	* 18	: 18
: 19	: 19	: 19	: 19
: 20	: 20	: 20	: 20
* 21	: 21	: 21	: 21
: 22	: 22	: 22	* 22
: 23	: 23	: 23	: 23
: 24	: 24	: 24	: 24
: 25	* 25	* 25	: 25
: 26	: 26	: 26	: 26
: 27	: 27	: 27	: 27
* 28	: 28	: 28	: 28
: 29		: 29	* 29
: 30		: 30	: 30
: 31		: 31	

1979 SEPTEMBER	1979 OCTOBER	1979 NOVEMBER	1979 DECEMBER
: 1	: 1	: 1	: 1
* 2	: 2	: 2	* 2
: 3	: 3	: 3	: 3
: 4	: 4	* 4	: 4
: 5	: 5	: 5	: 5
: 6	: 6	: 6	: 6
: 7	* 7	: 7	: 7
: 8	: 8	: 8	: 8
* 9	: 9	: 9	* 9
: 10	: 10	: 10	: 10
: 11	: 11	* 11	: 11
: 12	: 12	: 12	: 12
: 13	: 13	: 13	: 13
: 14	* 14	: 14	: 14
: 15	: 15	: 15	: 15
* 16	: 16	: 16	* 16
: 17	: 17	: 17	: 17
: 18	: 18	* 18	: 18
: 19	: 19	: 19	: 19
: 20	: 20	: 20	: 20
: 21	* 21	: 21	: 21
: 22	: 22	: 22	: 22
* 23	: 23	: 23	* 23
: 24	: 24	: 24	: 24
: 25	: 25	* 25	: 25
: 26	: 26	: 26	: 26
: 27	: 27	: 27	: 27
: 28	* 28	: 28	: 28
: 29	: 29	: 29	: 29
* 30	: 30	: 30	* 30
	: 31	:	: 31

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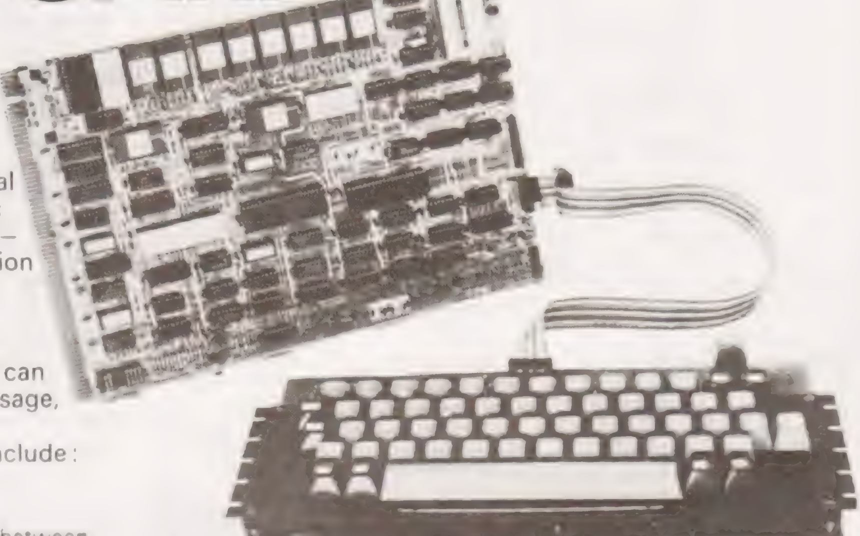

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Phil Cornes

The final part of our popular series on BASIC programming

We started this series with algorithms and flow charts, and that is how we finish. In this, the last part of our BASIC series, we look at a flow chart and program for the binary search algorithm presented last month, and we also take a look at a very efficient sort routine.

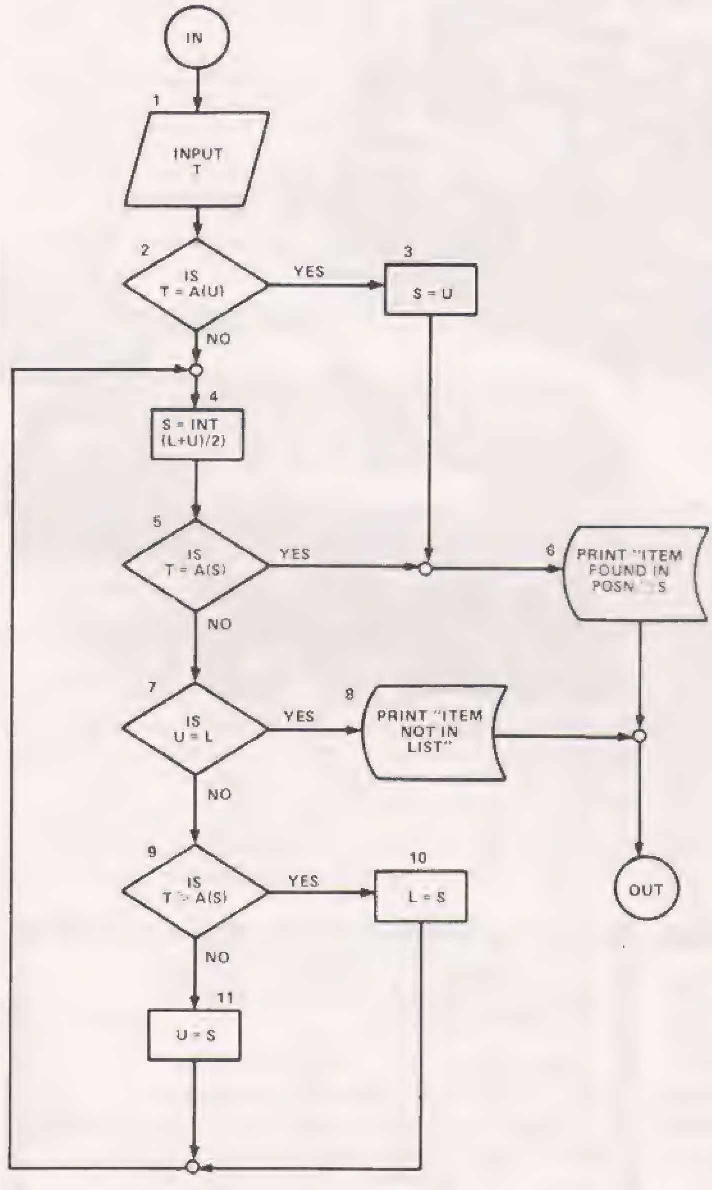

Fig.1. The Binary search flowchart.

Binary Search

A flow chart to perform the Binary Search algorithm might be as Fig.1. We assume that this routine is being used as part of a larger program so that U and L already have values. U is the pointer for the upper limit of the interval, yet to be searched and L is the pointer for the lower limit on this interval. So, for example, if the list to be searched contains 100 items, then U would be 100 and L would be 1. Flow chart box 1 asks for a value which will be assigned to the variable T. This is the number that we are going to search for in the list. Flow chart box 2 is looking to see if our input value is contained in the last position of the list. If it is, we branch through box 3 to box 6 to print the message saying that we have found the required item and to give its position (we will look at why this box is needed later).

If T is not in A(U) then we move on to box 4. This starts the algorithm proper by calculating the mid-position in the list and assigning this value to the variable S. A check is then made by box 5 to see if A(S) – the contents of the list position just calculated – is equal to T. If it is, we move to box 6 to indicate our success in locating item T, otherwise we move on to box 7. Box 7 is asking whether the upper and lower list pointers are equal because if they are then there is no point in trying to locate T anymore as there are no more positions between U and L to look in, so we would move to box 8 and indicate that T was not contained in the list. If U and L are not equal, the next task is to decide if T is contained in the interval between U and S or between L and S. As the list is in numerical order, this is achieved simply by comparing T with the current value of A(S). If T is greater than A(S) then T is contained in the lower half of the list and we bring the upper bound U down to S (flowchart box 11). We then branch back to box 4 to calculate the mid-position of the new interval (S) and start over again.

This process continues until we either find the item T somewhere in the list and print this fact or prove that the item T is not contained in the list at all. A program segment with the function of the flowchart of Fig.1 is given below.

```
100 ....
110 INPUT T
120 IF T=A(U) THEN 230
130 S=INT((L+U)/2)
140 IF T=A(S) THEN 240
150 IF U=L THEN 210
160 IF T > A(S) THEN 190
170 U=S
180 GOTO 130
190 L=S
200 GOTO 130
210 PRINT "ITEM NOT IN LIST"
220 GOTO 250
230 S=U
240 PRINT "ITEM FOUND IN POSITION";S
250 ....
```

Earlier we said that we would look at the need for flowchart box 2 in Fig.1, and we will do this now with reference to the above program. We will dry-run it with U=3 and L=1 giving us a list of 3 items. (Say A(1)=10, A(2)=12 and A(3)=52). Program line 120 above corresponds to box 2 in Fig.1 and we will omit it mentally and see what happens when we input a value of 52 for T in line 110 above. Line 130 assigns a value of 2 to S (L+U=4, 4/2=2, INT(2)=2, S=2). T is not equal to 12, the value of A(2) in line 40 and so we move on to line 150. U is not equal to L, and so on to 160. T is greater than A(2) which shows that if T is contained in the list at all it must be in the upper half.

We now set L to S (line 190) which gives L=2, U=3. Line 200 takes us back to line 130 where a new value of S is calculated. (U+L=5, 5/2=2.5, INT(2.5)=2, S=2).

Now, T is not equal to A(S) – line 140
U is not equal to L – line 150
and T is greater than A(S) – line 160

so we make L=S (which it already is) and branch back to 130. Now we see the problem. The INT function used in line

130 to calculate the mid-position of U and L will only round down to the nearest integer — it cannot round up — and consequently we can never look at the last item in the list to see if it contains T. Obviously, then, when the last list position does contain T the algorithm would not terminate without the inclusion of some test (Fig.1, box 2 for example) to see if T were contained in the last list position.

Efficient Algorithm

You may remember from last month that the binary search algorithm is much more efficient than a simple search, but it suffers from the drawback that the list to be searched has to be in ascending numerical order. The process of sorting a list into order can in itself be very lengthy, especially if we use a simple sort routine given earlier in the series. Fortunately there is a sort routine which is very efficient and is based on the merge of two sorted lists that we saw in a previous article. If you can imagine an unsorted list of eight items then this algorithm would take each of the 4 consecutive pairs of numbers in this list in turn and perform a two list merge on them which will give four pairs of numbers each of which will be in numeric order. The algorithm then takes the first two pairs thus generated and merges them to form a sorted list of four numbers and then takes the second two pairs and merges these also.

We now have two sets of four numbers, each set being in numerical order. The final process is to merge these two lists of four items into one list of 8 items and the sort is complete (see Fig.2). The flowchart of this algorithm is given as Fig.3. The program is given below.

```
  5  REM ==MERGE SORT==
 10  PRINT"HOW MANY ITEMS TO BE SORTED";
 20  INPUT T
 30  A=1
 40  IF A>T THEN 70
 50  A=A * 2
 60  GOTO 40
 70  N=A
 75  DIMA(A/2+1),B(A/2+1),C(A+1)
 80  FOR X=T+1 TO N
 90  C(X)=1E30
100  NEXT X
110  PRINT"INPUT VALUES TO GO IN LIST"
120  FOR X = 1 TO T
130  PRINT X,
140  INPUT C(X)
150  NEXT X
160  PRINT"SORT BEGINS NOW"
170  D=1
180  A=1
190  B=1
200  C=1
210 FOR X = 1 TO T
220  B(B)=C(C)
230  B=B+1
240  C=C+1
250  NEXT X
260  FOR X=1 TO D
270  A(A)=C(C)
280  A=A+1
290  C=C+1
300  NEXT X
310  IF C<>N+1 THEN 210
320  A=1
330  B=1
```

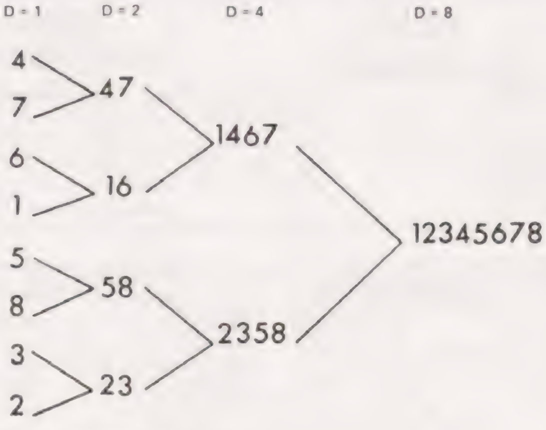

Fig.2. The 'Merge-Sort' process.

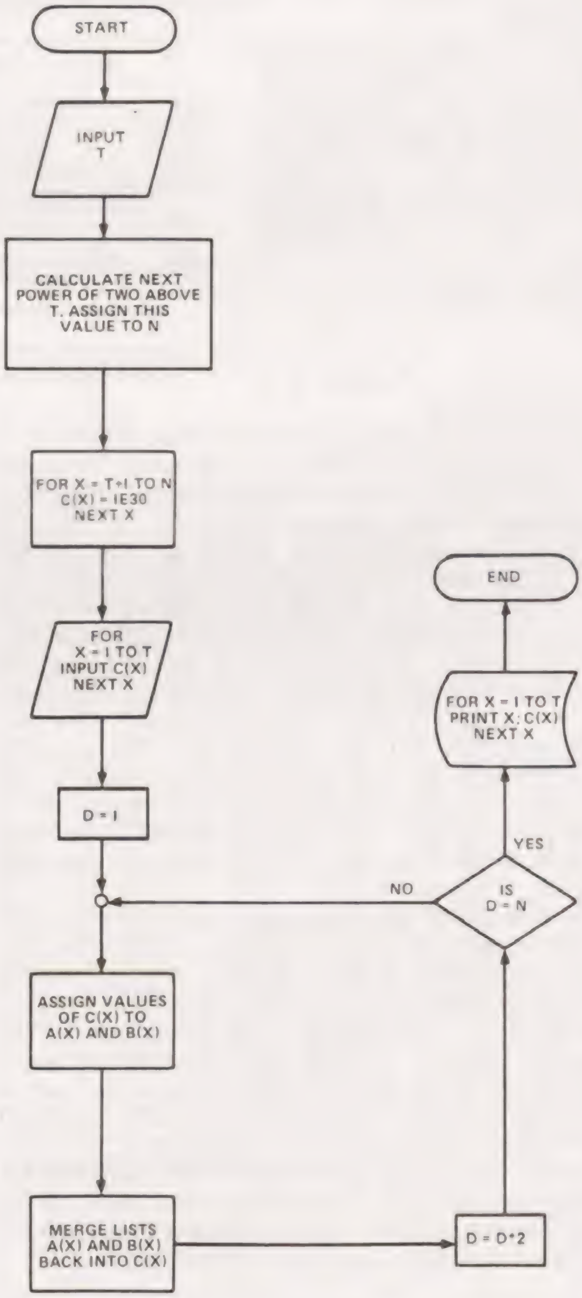

Fig.3. The 'Final Programme' flowchart.

```
340  C=1
350  S=A−1
360  IF A(A) > B(B) THEN 400
370  C(C)=A(A)
380  A=A+1
390  GOTO 420
400  C(C)=B(B)
410  B=B+1
420  C=C+1
430  IF A=S+D+1 THEN 520
440  IF B=S+D+1 THEN 460
450  GOTO 360
460  FOR X = A TO S+D
470  C(C)=A(A)
480  C=C+1
490  A=A+1
500  NEXT X
510  GOTO 570
520  FOR X = B TO S+D
530  C(C)=B(B)
540  C=C+1
550  B=B+1
560  NEXT X
570  IF A+B < N+2 THEN 350
580  D=D * 2
590  IF D <> N THEN 180
600  PRINT"THE SORTED LIST IS"
610  FOR X=1 TO T
620  PRINT"    ";X;C(X)
630  NEXT X
640  END
```

How The Sort Operates

The program as given is not as condensed or as efficient as it could be. This is to make it easier to understand. No doubt when you have worked out the details of its operation, most of you could make several improvements.

The program starts off by taking an input to the variable T. This is used to tell the program how many items are to be sorted. The next part of the program (lines 30 to 70) calculates the next power of 2 above the input value (T). This value is assigned to the variable N and is the actual number of items that will be sorted. Next items, T+1 To N, are made very large (1E30) so that after sorting they will still occupy positions T+1 TO N in list C(X). The sort now begins. The 'INPUT' list C(X) is first split up into two lists A(X) and B(X) by lines 210–310. This is done in rather a special way. The variable D is used to indicate the number of values in A(X) and B(X) that are to be merged in each step (see Fig.2).

The first D (initially D=1) items in C(X) are assigned to the first D items in A(X), then the second D items in C(X) are assigned to the first D items in B(X), then the third D items in C(X) are assigned to the second D items in A(X) . . . . then B(X) . . . . . then A(X) and so on until all of C(X) has been thus assigned. Program lines 350–590 are essentially the two list merge program given in an earlier part of this series, and are used to merge sort lists A(X) and B(X) back into list C(X) again in blocks of 2 from D.

Consider the following example:– The four item list 4 1 2 3 is to be sorted. The important variables (A(X), B(X), C(X) and D) would take the various values given in Table 1 at various times during the execution of the program.

The Final Programme

For homework this month (which will, of course remain unanswered as this is the last part of the series – maudlin sob) (hearty cheer, really, but you've got to sound sad, haven't you) is to work out the fine details of the above program with the aid of flowchart Fig.3.

All that remains now is for me to say that I hope you have all learned as much from reading this series as I have from writing it and that the experience has been enjoyable.

PROGRAM LINES	D	A(1)	A(2)	B(1)	B(2)	C(1)	C(2)	C(3)	C(4)
110–170	1	X	X	X	X	4	1	2	3
180–310		4	2	1	3				
320–570						1	4	2	3
580	2								
180–310		1	4	2	3				
320–570						1	2	3	4
580	4	– sort complete							

Table 1. The 'X' in the table is a 'don't care' value.

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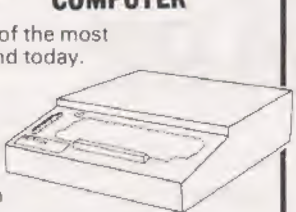

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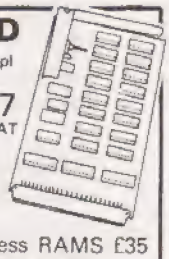

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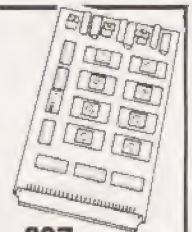

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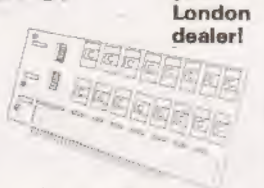

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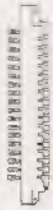

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SN74LS38N	29	SN74LS123N	90	SN74LS175N	1.05	SN74LS280N	1.75	SN74LS445N	1.25
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With this package, you can make your TRS-80 a working partner. Order No. 0013R 21.66.

PERSONAL FINANCE I Let your TRS-80 handle all the tedious details the next time you figure your finances:

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All you need is a TRS-80 Level II 16K. Order No. 0072R 5.75.

PET

CASINO I These two programs are so good, you can use them to check out and debug your own gambling system!

Roulette — Pick your number and place your bet with the computer version of this casino game. For one player.

Blackjack — Try out this version of the popular card game before you go out and risk your money on your own "surefire" system. For one player.

This package requires a PET with 8K. Order No. 0014P 5.75.

CASINO II This craps program is so good, it's the next best thing to being in Las Vegas or Atlantic City. It will not only play the game with you, but also will teach you how to play the odds and make the best bets. A one player game, it requires a PET 8K. Order No. 0015P 5.75.

CHECKERS/BACCARAT Play two old favourites with your PET.

Checkers — Let your PET be your ever-ready opponent in this computer-based checkers program.

Baccarat — You have both Casino- and Blackjack-style games in this realistic program.

Your PET with 8K will offer challenging play anytime you want. Order No. 0022P 5.75.

MIMIC Test your memory and reflexes with the five different versions of this game. You must match the sequence and location of signals displayed by your PET. This one-player program includes optional sound effects with the PET 8K. Order No. 0039P 5.75.

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TURF AND TARGET Whether on the field or in the air, you'll have fun with Turf and Target package. Included are:

Quarterback — You're the quarterback as you try to get the pigskin over the goal line. You can pass, punt, hand off, and see the results of your play using the PET's superb graphics.

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Target — Use the numeric keypad to shoot your puck into the hom position as fast as you can.

To run and score all you'll need is a PET with 8K. Order No. 0097P 5.75.

ARCADE I This package combines an exciting outdoors sport with one of America's most popular indoor sports:

Kite Fight — It's a national sport in India. After you and a friend have spent several hours manoeuvering your kites across the screen of your PET, you'll know why!

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Requires an 8K PET. Order No. 0074P 5.75.

ARCADE II One challenging memory game and two fast-paced action games make this one package the whole family will enjoy for some time to come. Package includes:

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Blockade — A two-player game that combines strategy and fast reflexes.

Requires 8K PET. Order No. 0045P 5.75.

DUNGEON OF DEATH Battle evil demons, cast magic spells, and accumulate great wealth as you search for the Holy Grail. You'll have to descend into the Dungeon of Death and grope through the suffocating darkness. If you survive, glory and treasure are yours. For the PET 8K. Order No. 0064P 5.75.

Apple

MATH TUTOR I Parents, teachers, students, now you can turn your Apple computer into a mathematics tutor. Your children or students can begin to enjoy their math lessons with these programs:

Hanging — Perfect your skill with decimal numbers while you try to cheat the hangman.

Spellbinder — Cast spells against a competing magician as you practice working with fractions.

Whole Space — While you exercise your skill at using whole numbers your ship attacks the enemy planet and destroys alien spacecraft.

All programs have varying levels of difficulty. All you need is Applesoft II with your Apple II 24K. Order No. 0073A 5.75.

MATH TUTOR II Your Apple computer can go beyond game playing and become a mathematics tutor for your children. Using the technique of immediate positive reinforcement, you can make math fun with:

Car Jump — Reinforce the concept of calculating area while having fun making your car jump over the ramps.

Robot Duel — Practice figuring volumes of various containers while your robot fights against the computer's mechanical man.

Sub Attack — Take the mystery out of working with percentages as your submarine sneaks into the harbor and destroys the enemy fleet.

All you need is Applesoft II with your Apple II and 20K. Order No. 0098A 5.75.

GOLF Without leaving the comfort of your chair, you can enjoy a computerized 18 holes of golf with a complete choice of clubs and shooting angles. You need never cancel this game because of rain. One or two players can enjoy this game on the Apple with Applesoft II and 20K. Order No. 0018A 5.75.

BOWLING/TRILOGY Enjoy two of America's favorite games transformed into programs for your Apple:

Bowling — Up to four players can bowl while the Apple sets up the pins and keeps score. Requires Applesoft II.

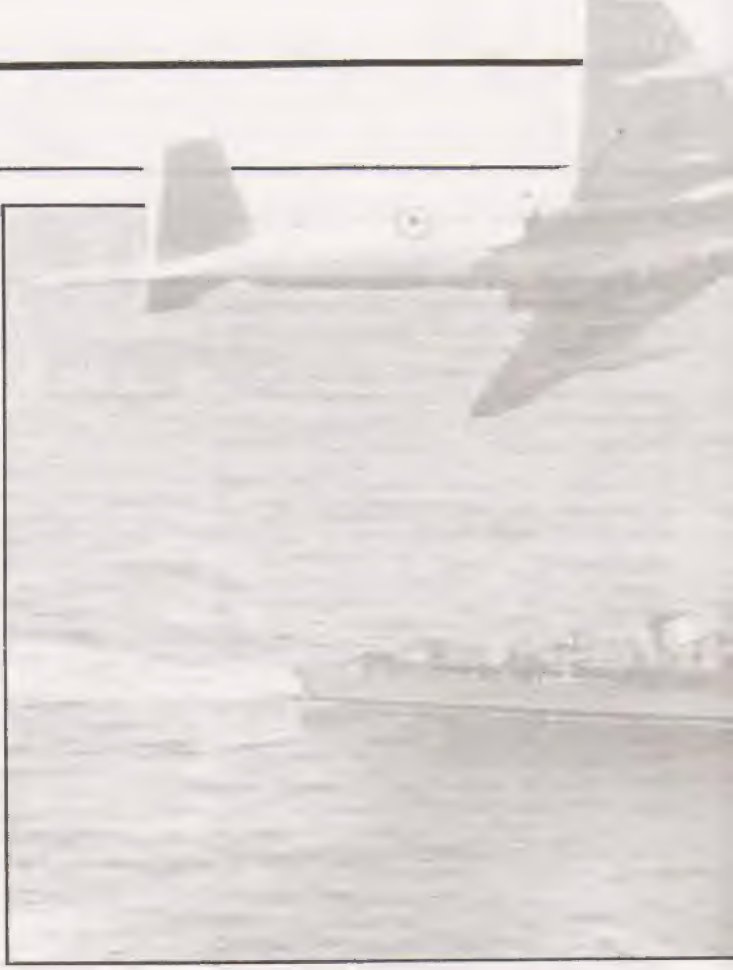
Trilogy — This program can be anything from a simple game of tic-tac-toe to an exercise in deductive logic. For one player.

This fun-filled package requires an Apple with 20K. Order No. 0040A 5.75.

Matt Lindsell

A calculator game of strategy. Will you survive long enough to torpedo the destroyer or will you be found by the depth charges first?

The game is set in the Pacific Ocean. An enemy destroyer has infringed the international boundaries, on a hostile mission. The enemy have, in addition, stolen an RAF Nimrod submarine hunter. Co-ordinated by the ship, this proves a formidable weapon; however, if you eliminate the destroyer, you also put this aircraft to rout.



Setting The Scene

You command the Royal Naval submarine, HMS Oceannought. Belonging to a new and revolutionary class of submarines, HMS Oceannought is capable of firing both, torpedos, and Polaris ballistic missiles, although on account of the modifications necessary to use both, only a single weapon may be fired at one shot. The submarine is armed with an effectively limitless supply of both torpedos and missiles! In command of HMS Oceannought, your orders are clear; annihilate the hostile destroyer before it annihilates you. The enemy is armed with ship-to-ship rockets, which he fires in salvos at intervals, although being under water, most of these cause little or no damage, being poorly aimed. Your underwater "Camouflage" also hides you from the aircraft for most of the time. However, during the course of the engagement, the hostile vessel moves inexorably on, towards you, in order to get a better fix on your position (the attacks become more frequent as the game progresses) and also to drop depth charges. Although a missile dropped immediately above the submarine at the surface of the ocean is distant enough from the submarine not to destroy it, it cannot destroy the enemy either, as he anticipates this strategy and keeps a safe distance, also keeping out of visual contact, but remaining still sufficiently close to strike with depth charges.

The game begins as you pick up a faint blip on your radar, indicating the enemy's presence in the semi-circle of sea in front of your vessel, but not revealing his location or bearing relative to yourself. Once in range the intruder follows you where ever you move narrowing the distance separating you. Up until now you have been floating near the surface, scanning with your periscope; you order the periscope down, and dive! You commence the assault immediately, starting with perhaps random shots aimed within the semi-circle of your radar sweep, but bearing in mind that the intruder is continually moving towards you, and is thus unlikely to be located at the outer fringe of radar field after several shots have been exchanged.

Escape is impossible, since surface vessels can move faster than submerged ones .... You must fight to the death!

User Instructions

1. To start the game, first ensure the Master Library Module is in position. Next, ensure the calculator is connected to a print cradle of the PC–100' series, and check that the partition is set to 559.49 (ie press – 5 2nd Op 1 7). Now, enter the program and data memories, either directly, or from each side of two magnetic cards.

   Press A. (First user-defined key)

   After a short while, the following is printed:–

```
*DESTROYER ON RADAR*
    DOWN PERISCOPE
   DIVING STATIONS
        DIVE!
        DIVE!
        DIVE!
```

   (Note: before pressing A, a new random number seed between 0 and 199017 (inc) may be entered into register 9)

   The calculator has now placed the destroyer randomly within the semi-circle shown above.

2. Commence attack: If it is desired to shoot a torpedo, enter the bearing at which it is to be directed (as above) in degrees (after checking calculator is in degree mode) and press C. If it is desired to fire a ballistic missile, enter the rectangular co-ordinates of the target point, in the following format:– XXX.YYY where both XXX and YYY are right adjusted integers, in the range 0 – 100 for YYY, and –100 – +100 for XXX and press B. Thus a torpedo shot at 45° travels in a North Easterly direction, but one shot at 135° goes North West.

   A Missile directed at a position of 50.025 lands at the point where X = 50, and Y = 25 (Bearing East North

MARITIME STRIKE

East;) whereas a missile directed at –50.025, lands at the point where X = –50, and Y = +25 (Bearing West North West).

The torpedos are triggered magnetically by sensing a metallic ships hull. Therefore they will score a direct hit on anything within 2 units of their bearing line. Missiles, though, are triggered by the impact as they strike the water's surface. Therefore, they explode anyway (unlike torpedos which, if out of range simply pass by). The force of the explosion scores a direct to anything within 2 units of the impact point, but is sufficient to additionally score a minor hit on anything within 8 units of the impact point. The enemy can sustain four such minor hits and still continue the attack. The fifth minor hit however is fatal and destroys the enemy. The resulting explosion etc, as the intruder sinks, betrays its final position to your submarine's radar, and the enemy position is printed after the statement "Direct Hit!" or "Fatal Minor Hit!".

3. Optional, but not recommended – Cheat button. Pressing E causes the enemy position to be printed.

Scaling The Game

The following Constants and Variables may be altered to suit inidividual ability.

Description of number	Program location of No.
Safety factor (Variable – Register 13) set to 6 at beginning of game but decreases as game progress. The bigger it is, the less likely the enemy is to attack you.	set at 236
Missile minor hit radius (8)	095 & 096
Missile direct hit radius (2)	092
Torpedo direct hit radius (2)	229
Escape factors, the bigger they are, the less likely you are to be destroyed when attacked by the method concerned.	
Rocket Salvo (8)	356
Nimrod aircraft (9)	533
Depth charges (7)	461

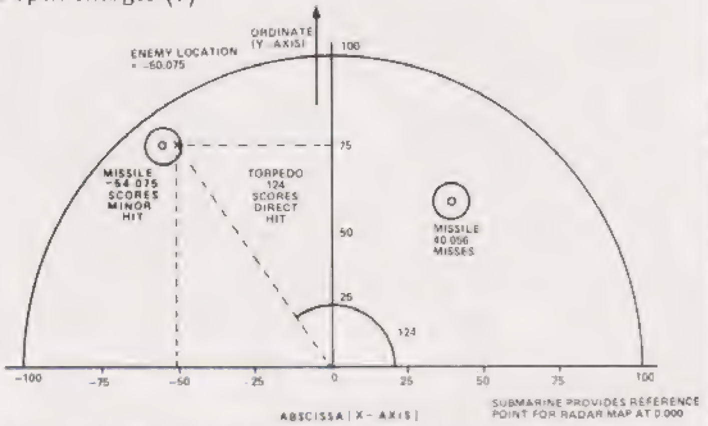


Fig.1. The radar field grid showing destroyer location and attempted strikes.

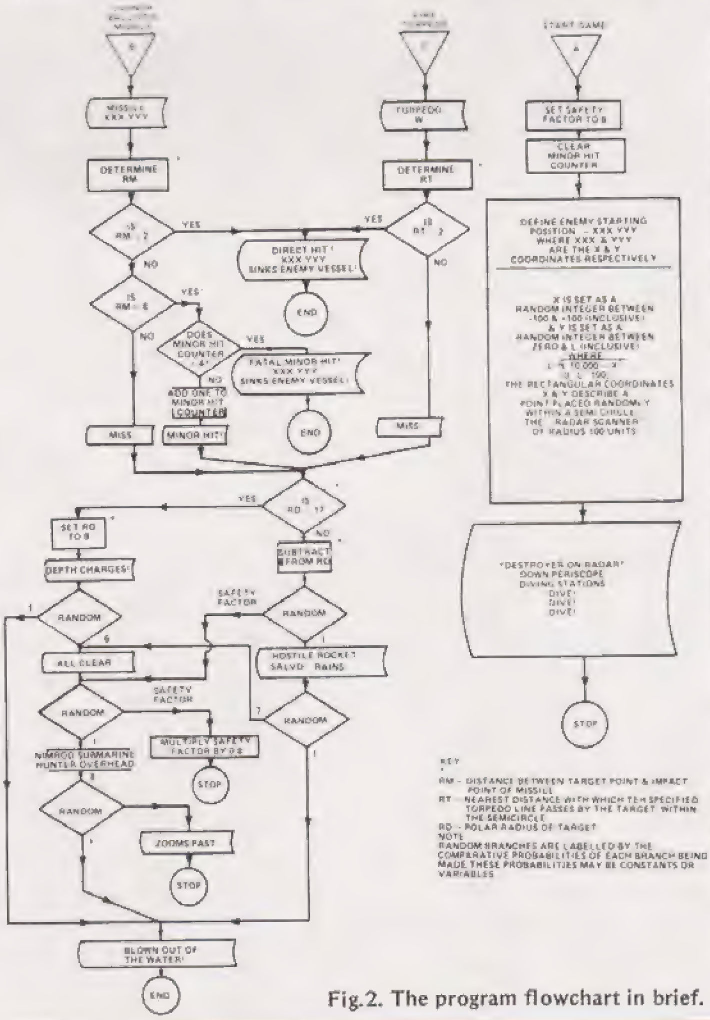


Fig.2. The program flowchart in brief.

Fig.3. The data memories required.

		1335243117.	16	4137003221.	33
5116173637.	00	2341313717.	17	1617333723.	34
3532451735.	01	3500324217.	18	15231335.	35
32310035.	02	3523171316.	19	2217360073.	36
1316133551.	03	30243636.	20	3615323317.	37
1624422431.	04	3624312636.	21	1527171335.	38
2200363713.	05	17311730.	22	2435171537.	39
3724323136.	06	4500421736.	23	0.	40
0.	07	3617270073.	24	16324331.	41
4632323036.	08	2332363724.	25	2427170000.	42
0.	09	2717003532.	26	1624421773.	43
23243773.	10	1526173700.	27	0.	44
37323533.	11	3613274232.	28	0.	45
1716320000.	12	3723170043.	29	0.	46
0.	13	1337173573.	30	0.	47
2430353216.	14	4040401427.	31	3024313235.	48
36411430.	15	3243310032.	32	1337132700.	49

Fig.4. The program listing for Maritime Strike

```
000  76 LBL
001  16 A'
002  42 STO
003  07  07
004  73 RC*
005  07  07
006  69 OP
007  01  01
008  76 LBL
009  17 B'
010  69 OP
011  27  27
012  73 RC*
013  07  07
014  69 OP
015  02  02
016  69 OP
017  27  27
018  73 RC*
019  07  07
020  69 OP
021  03  03
022  69 OP
023  27  27
024  73 RC*
025  07  07
026  69 OP
027  04  04
028  69 OP
029  05  05
030  92 RTN
031  76 LBL
032  10 E'
033  36 PGM
034  15  15
035  71 SBR
036  88 DMS
037  92 RTN
038  76 LBL
039  12  B
040  32 X:T
041  43 RCL
042  20  20
043  69 OP
044  00  00
045  69 OP
046  02  02
047  43 RCL
048  42  42
049  69 OP
050  03  03
051  98 ADV
052  69 OP
053  05  05
054  58 FIX
055  03  03
056  32 X:T
057  99 PRT
058  22 INV
059  58 FIX
060  42 STO
061  45  45
062  59 INT
063  42 STO
064  44  44
065  22 INV
066  44 SUM
067  45  45
068  03  3
069  22 INV
070  28 LOG
071  49 PRD
072  45  45
073  43 RCL
074  46  46
075  75  -
076  43 RCL
077  44  44
078  95  =
079  32 X:T
080  43 RCL
081  47  47
082  75  -
083  43 RCL
084  45  45
085  50 I×I
086  95  =
087  22 INV
088  37 P/R
089  32 X:T
090  50 I×I
091  32 X:T
092  02  2
093  77  GE
094  38 SIN
095  08  8
096  68 NOP
097  77  GE
098  39 COS
099  76 LBL
100  60 DEG
101  69 OP
102  00  00
103  43 RCL
104  20  20
105  69 OP
106  02  02
107  69 OP
108  05  05
109  61 GTO
110  50 I×I
111  76 LBL
112  38 SIN
113  69 OP
114  00  00
115  01  1
116  06  6
117  69 OP
118  01  01
119  43 RCL
120  39  39
121  69 OP
122  02  02
123  43 RCL
124  10  10
125  69 OP
126  03  03
127  69 OP
128  05  05
129  15  E
130  76 LBL
131  30 TAN
132  02  2
133  01  1
```

134	69	OP	187	03	03	240	65	×	293	37	37
135	01	01	188	98	ADV	241	02	2	294	69	OP
136	43	RCL	189	69	OP	242	00	0	295	04	04
137	49	49	190	05	05	243	01	1	296	69	OP
138	69	OP	191	43	RCL	244	95	=	297	05	05
139	02	02	192	45	45	245	59	INT	298	98	ADV
140	69	OP	193	99	PRT	246	75	-	299	17	B'
141	05	05	194	43	RCL	247	01	1	300	98	ADV
142	76	LBL	195	46	46	248	00	0	301	69	OP
143	15	E	196	32	X:T	249	00	0	302	00	00
144	25	CLR	197	43	RCL	250	95	=	303	43	RCL
145	35	1/X	198	47	47	251	42	STO	304	43	43
146	35	1/X	199	22	INV	252	46	46	305	69	OP
147	24	CE	200	37	P/R	253	33	X²	306	03	03
148	44	SUM	201	32	X:T	254	75	-	307	69	OP
149	46	46	202	48	EXC	255	04	4	308	05	05
150	43	RCL	203	45	45	256	22	INV	309	69	OP
151	47	47	204	75	-	257	28	LOG	310	05	05
152	55	÷	205	32	X:T	258	95	=	311	69	OP
153	03	3	206	95	=	259	94	+/-	312	05	05
154	22	INV	207	50	I×I	260	34	√X	313	98	ADV
155	28	LOG	208	32	X:T	261	32	X:T	314	25	CLR
156	65	×	209	43	RCL	262	10	E'	315	42	STO
157	43	RCL	210	45	45	263	65	×	316	40	40
158	46	46	211	32	X:T	264	32	X:T	317	91	R/S
159	69	OP	212	37	P/R	265	85	+	318	76	LBL
160	10	10	213	50	I×I	266	93	.	319	79	x̄
161	85	+	214	42	STO	267	05	5	320	01	1
162	43	RCL	215	44	44	268	95	=	321	32	X:T
163	46	46	216	32	X:T	269	59	INT	322	10	E'
164	95	=	217	29	CP	270	42	STO	323	65	×
165	58	FIX	218	77	GE	271	47	47	324	43	RCL
166	03	03	219	77	GE	272	98	ADV	325	13	13
167	99	PRT	220	43	RCL	273	25	CLR	326	95	=
168	22	INV	221	45	45	274	16	A'	327	77	GE
169	58	FIX	222	42	STO	275	98	ADV	328	45	Yˣ
170	02	2	223	44	44	276	69	OP	329	02	2
171	01	1	224	76	LBL	277	00	00	330	05	5
172	16	A'	225	77	GE	278	43	RCL	331	98	ADV
173	19	D'	226	43	RCL	279	41	41	332	16	A'
174	76	LBL	227	44	44	280	69	OP	333	69	OP
175	13	C	228	32	X:T	281	02	02	334	00	00
176	42	STO	229	02	2	282	03	3	335	03	3
177	45	45	230	77	GE	283	03	3	336	05	5
178	43	RCL	231	38	SIN	284	01	1	337	01	1
179	11	11	232	61	GTO	285	07	7	338	03	3
180	69	OP	233	60	DEG	286	03	3	339	02	2
181	00	00	234	76	LBL	287	05	5	340	04	4
182	69	OP	235	11	A	288	02	2	341	03	3
183	02	02	236	06	6	289	04	4	342	01	1
184	43	RCL	237	42	STO	290	69	OP	343	03	3
185	12	12	238	13	13	291	03	03	344	06	6
186	69	OP	239	10	E'	292	43	RCL	345	69	OP

346	02	02
347	43	RCL
348	41	41
349	69	OP
350	03	03
351	69	OP
352	05	05
353	98	ADV
354	10	E'
355	65	×
356	08	8
357	95	=
358	32	X:T
359	01	1
360	22	INV
361	77	GE
362	35	1/X
363	76	LBL
364	58	FIX
365	98	ADV
366	69	OP
367	00	00
368	03	3
369	00	0
370	42	STO
371	07	07
372	17	B'
373	69	OP
374	00	00
375	43	RCL
376	29	29
377	69	OP
378	03	03
379	43	RCL
380	30	30
381	69	OP
382	04	04
383	76	LBL
384	98	ADV
385	69	OP
386	05	05
387	76	LBL
388	19	D'
389	98	ADV
390	98	ADV
391	98	ADV
392	98	ADV
393	25	CLR
394	91	R/S
395	76	LBL
396	39	COS
397	69	OP
398	00	00
399	43	RCL
400	48	48
401	69	OP
402	03	03
403	43	RCL
404	10	10
405	69	OP
406	04	04
407	04	4
408	32	X:T
409	43	RCL
410	40	40
411	67	EQ
412	30	TAN
413	69	OP
414	05	05
415	01	1
416	44	SUM
417	40	40
418	76	LBL
419	50	I×I
420	43	RCL
421	46	46
422	32	X:T
423	43	RCL
424	47	47
425	22	INV
426	37	P/R
427	42	STO
428	07	07
429	01	1
430	07	7
431	77	GE
432	48	EXC
433	32	X:T
434	76	LBL
435	48	EXC
436	75	-
437	08	8
438	95	=
439	42	STO
440	45	45
441	32	X:T
442	43	RCL
443	07	07
444	37	P/R
445	59	INT
446	42	STO
447	47	47
448	32	X:T
449	59	INT
450	42	STO
451	46	46
452	43	RCL
453	45	45
454	32	X:T
455	09	9
456	22	INV
457	77	GE
458	79	x̄
459	10	E'
460	65	×
461	07	7
462	95	=
463	32	X:T
464	69	OP
465	00	00
466	03	3
467	03	3
468	42	STO
469	07	07
470	98	ADV
471	17	B'
472	98	ADV
473	01	1
474	77	GE
475	58	FIX
476	76	LBL
477	35	1/X
478	69	OP
479	00	00
480	01	1
481	03	3
482	02	2
483	07	7
484	02	2
485	07	7
486	00	0
487	00	0
488	69	OP
489	02	02
490	43	RCL
491	38	38
492	69	OP
493	03	03
494	69	OP
495	05	05
496	76	LBL
497	45	Y^X
498	10	E'
499	65	×
500	43	RCL
501	13	13
502	95	=
503	32	X:T
504	01	1
505	77	GE
506	23	LNX
507	93	.
508	08	8
509	49	PRD
510	13	13
511	98	ADV
512	25	CLR
513	92	RTN
514	76	LBL
515	23	LNX
516	03	3
517	01	1
518	69	OP
519	01	01
520	01	1
521	03	3
522	42	STO
523	07	07
524	98	ADV
525	17	B'
526	69	OP
527	00	00
528	17	B'
529	01	1
530	32	X:T
531	10	E'
532	65	×
533	09	9
534	95	=
535	22	INV
536	77	GE
537	58	FIX
538	69	OP
539	00	00
540	43	RCL
541	08	08
542	69	OP
543	02	02
544	03	3
545	03	3
546	01	1
547	03	3
548	03	3
549	06	6
550	03	3
551	07	7
552	69	OP
553	03	03
554	98	ADV
555	69	OP
556	05	05
557	98	ADV
558	25	CLR
559	91	R/S

Fig.5. Sample games of Maritime Strike showing key strokes. See text for explanation.

```
A
*DESTROYER ON RADAR*

      DOWN PERISCOPE

     DIVING STATIONS

         DIVE!
         DIVE!
         DIVE!
C
      TORPEDO
        90.
      MISS

HOSTILE ROCKET SALVO
     RAINS DOWN

      ALL CLEAR
C
      TORPEDO
        135.
      MISS
C
      TORPEDO
        45.
      MISS

     DEPTH CHARGES !

      ALL CLEAR

    NIMROD SUBMARINE
     HUNTER OVERHEAD

     ZOOMS PAST
B
      MISSILE
       0.012
      MISS

     DEPTH CHARGES !

     ...BLOWN OUT OF
           THE WATER!
```

```
A
*DESTROYER ON RADAR*

      DOWN PERISCOPE

     DIVING STATIONS

          DIVE!
          DIVE!
          DIVE!
C
      TORPEDO
        90.
      MISS
C
      TORPEDO
        45.
      MISS
C
      TORPEDO
        135.
      MISS

HOSTILE ROCKET SALVO
     RAINS DOWN

      ALL CLEAR
C
      TORPEDO
        67.5
    DIRECT HIT!
      26.066
SINKS ENEMY VESSEL !
A
*DESTROYER ON RADAR*

      DOWN PERISCOPE

     DIVING STATIONS

          DIVE!
          DIVE!
          DIVE!
```

```
C
      TORPEDO
        90.
      MISS
C
      TORPEDO
        135.
      MISS
C
      TORPEDO
        45.
      MISS

  NIMROD SUBMARINE
   HUNTER OVERHEAD

     ZOOMS PAST
B
      MISSILE
      30.045
          MINOR HIT!

   NIMROD SUBMARINE
    HUNTER OVERHEAD

     ZOOMS PAST
B
      MISSILE
      25.040
          MINOR HIT!
B
      MISSILE
      20.035
          MINOR HIT!
B
      MISSILE
      15.030
          MINOR HIT!
B
      MISSILE
      10.025
  FATAL MINOR HIT!
      13.019
SINKS ENEMY VESSEL !
```

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Ian Sinclair.

We take the first steps towards understanding the workings of the MK14 processor

At this point we take a big step forward, and start to look at the lowest priced commercial microprocessor unit, the Science of Cambridge Mk.14. Quite a lot has been written about this unit previously, and we're not going to repeat any of it here. If you ordered it in time, then you should have a working model ready now; if you didn't order early, then try 'phoning around for one, because several distributors have stocks.

Small Is Beautiful?

If you've never programmed a microprocessor at this level before, then the Mk.14 is a good inexpensive introduction to the art, from which you can learn a lot if you are prepared to work at it. The outstanding snags of the early models have now been ironed out, and everything in this series from now on refers to the latest (Issue 5) model. In my opinion you would learn little more about the use of the INS8060 by spending two or three times as much as this unit costs, whatever you might gain in operating convenience. If, of course, you *must* learn the use of another type of IC, that's different, but the less you spend on machine-code equipment the better – the next big step is to a computer programmed in BASIC; but that's another story.

The snag of the Mk.14, in common with many others, for the beginner, is the manual. There's nothing *wrong* with the manual as such; it's a useful compendium of information which has obviously been written by someone who is both knowledgeable and enthusiastic. He wasn't, however, engaged in teaching computing to beginners. For this reason, many beginners will find the manual intesely frustrating – the information which they need is there, but, being beginners, they can't find it. The remaining articles in this series are intended as a beginner's guide to the Mk.14 manual!

A Guide To Hardware

Let's start by examining the hardware. Assuming that you've stuck with this series so far, you will now have a fair idea of how the INS8060 goes about its work, so you should be able to appreciate how this unit, the Mk.14, differs from the simple breadboard system we've used so far.

The most fundamental and obvious difference is that this is a system which is operated by a monitor program which is stored in two ROM chips, IC2 and IC3. Each of these is a four-bit store, with IC2 storing the lowest four bits D_0 to D_3 of the byte, and IC3 storing the highest bits D_4 to D_7. Each IC permits 512 addresses, so that the two ROM's store a total of 512 complete bytes. In Hexadecimal, this is 01FF, and this is exactly the number of program steps in the monitor program. These ROM ICs are addressed by memory lines A_0 to A_8, so that information is read out of the ROMs whenever there is an address on these nine lines and the enable pin (pin 13) of each IC is taken low by IC17. In the older Mk.14's, IC17, a NAND gate was operated by the combination of read OR write signals, and an inverted A11 signal. This meant that each bit in ROM could be fetched by four lots of addresses as the program counter was incremented, because an address whose lower byte was, for example, AA, would be fetched at 01AA, 02AA, 03AA as well as 00AA. On the Issue 5 board, the gating has been changed so that the monitor program is stored only at addresses between 0000 and 01FF. The new gating which is drawn on the back of the circuit appears to omit bars above two of the address lines. As shown in the circuit, it would indicate that the monitor ROM was activated by A11, A10, A9; which would be an address starting with 011. This would start the monitor at 0110 0000 0000 (which is in hexadecimal 0600), and this just doesn't happen. I suspect that the A10 and A9 inputs to the gate have been inverted, so that the ROM is activated by A11, A10, A9, an address starting at 000 and followed by the 9-bit ROM address.

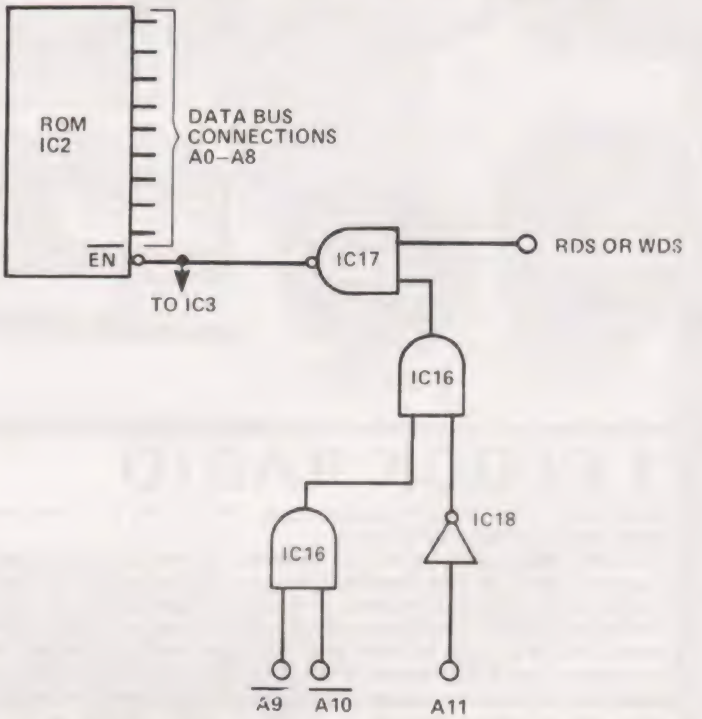


Fig.1. The ROM enable system. In the amended circuit shown in the manual, A9 and A10 (rather than A9 and A10) inputs are shown, but the decoding seems to use the zero rather than the 1 logic states on these lines. Note the small circle at the enable input which indicates that the voltage must go to logic 0 to enable the chip.

Because the board is double-sided, it's difficult to check the circuit by following the lines on the PCB, especially since they disappear under IC holders at frequent intervals. At any rate, the memory map on page 30 of the manual is out of date – the monitor ROM should appear only on the lowest portion of 512 bytes, and the standard RAM which is enabled by A11, A10, A9, A8 all high (addresses starting at 0F00 in hexadecimal) is at the top of the memory map.

That doesn't mean that you can write a program starting there, because the monitor stores some data in the locations 0F00 up to 0F11 (and some also at 0FF9 to 0FFF), so that your programs must start at 0F12 or higher, and stop before 0FF9. If you have the optional extra RAM, IC6, IC7 then this is activated when A8, A9, A11 are high and A10 low, so that the highest byte of the address is 1011 (Hexadecimal B), and addresses start at 0B00. All of these addresses are then available for programs – but if you need them you're no beginner! Note incidentally, that all the addresses we use on the Mk.14 begin with a zero, thus 0F00, 0B00. This is because the INS8060 has only twelve address lines, using three-byte addresses. The upper byte is obtained by strobing the data lines with the NADS signal and latching the outputs obtained from gates. This is not needed on the Mk.14.

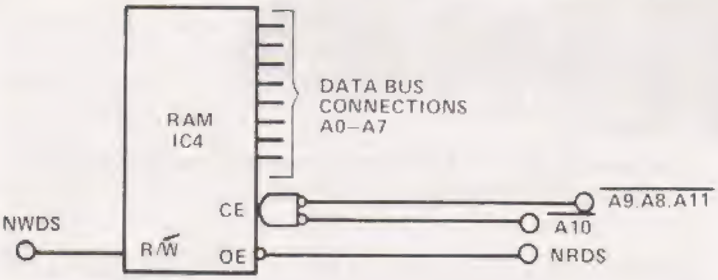


Fig.2. RAM enabling. The NWDS pulse sets the chip to write when an entry is being made into memory. At the same time, the chip-enable (CE) inputs must both be set low by the signals from address lines A8 to A11, all low. For reading, the NRDS strobe activates the "output enable" pin.

There is decoding present also for the RAM I/O chip which is another optional extra, bringing this IC into action by the address lines A7, A8 and A11. To enable this chip, A8 has to be low and A11 high; with A7 used to select whether the RAM or the In/Out section of the IC is to be used. We shall not be dealing with this option in this series.

This technique of using memory address signals on the higher memory lines to select RAM or ROM is called address decoding. The same technique is used to operate the display and the keyboard, of which more later.

Chips Displayed

Looking now at the microprocessor chip, IC1, itself, we can see what use is made of the signals which are available. The first point to note is the power supply inputs which take up the first six strips of the edge connector. If you don't have a suitable connector and you want to get going straight away, you can solder leads to lines 2 and 5, but don't, whatever you do, solder on to the edge-connecting strips themselves. The manual advises the use of a heatsink on the 7805 regulator only when inputs of more than 10 V are used, but it's *always* an advantage to bend the leads of this IC to an upright position and to bolt some finning to it. These regulator ICs are supposed to be short-circuit proof and to be protected against over-heating, but I've burned out a lot of them through this belief, and the one on my Mk.14 was no exception. A regulator foldback can cause *very* odd symptoms – the voltages read OK, the display lights, but the digits go bananas. On mine, I could enter numbers up to 9, but not higher. This was due to internal nasties happening to the bit of ROM which was being addressed at the time when the regulator went out of action, so the Mk.14 had to go back to S of C. Much to their credit, they had it back to me within a week, with a full explanation. From then on, I ran my Mk.14 with a Tandy heatsink on the regulator, and even with that it was pretty hot to the touch, so that greater the area of heatsink you can use without causing the whole thing to collapse with the weight the better.

Coming back to the INS8060, nine lines are taken out directly to the edge connector. These include the D7 and NADs lines, so that the HALT signals can be gated and used if wanted. The normal use of the Mk.14 does not make use of the HALT signal, because if the microprocessor halts, the display goes out and the keyboard no longer would operate! Unlike our simple unit, the display and entry systems of the Mk.14 depend on the operation of the microprocessor to keep them going by making use of the monitor program, reading in from the keyboard and out to the display and making use of the address decoding to sort out which is which. We'll look at how this is done in more detail later.

Connecting Edgewise

The edge connector also has the outputs Sout, F0, F1, F2, which are the serial and flag outputs which we monitored by using LEDs in the simple breadboard unit. The inputs SA, SB, Sin are also taken to the edge connector. The use of Sin has already been described, but SA and SB were not. These are inputs which read into the status register directly and which cannot be altered by any program instructions. The SA (sense–A) input will set bit 4 of the status register and cause the INS8060 to interrupt the program which it is carrying out and go to an address set by pointer P3. The sense–B input simply sets bit 5 of the status register, but doesn't cause any address change. You can't therefore run a program if SA is open-circuit or taken to logic 1, which is why the manual advises you to link the SA input to earth before attempting to enter a program. The best linking method is to use an edge connector with these two strips connected. If you have no edge connector and prefer to solder a permanent link across, keep the soldering clear of the edge strips.

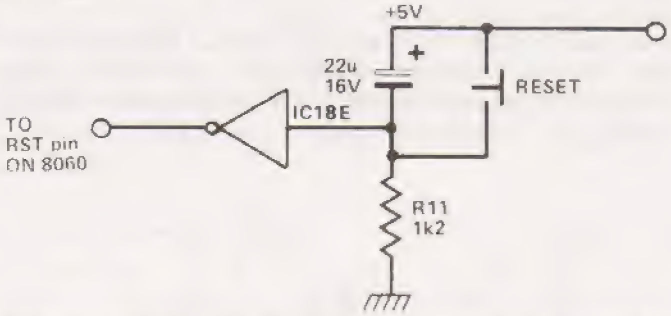


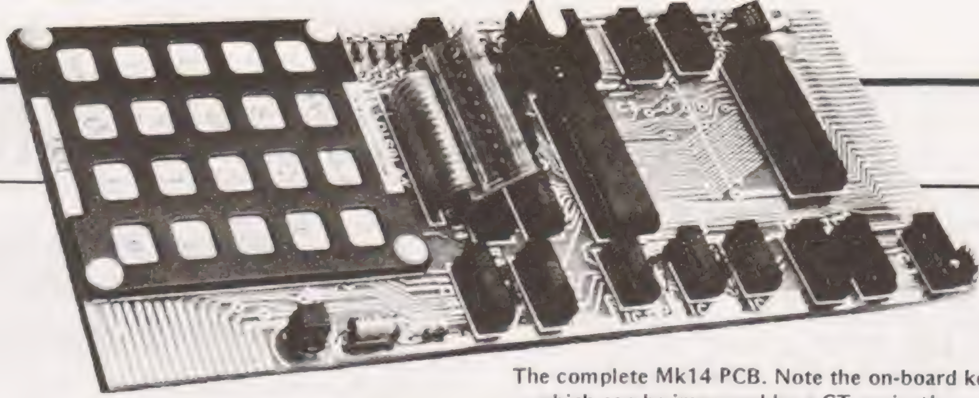
Fig.3. The RESET switch circuitry. The time constant of C6, R11 prevents the reset voltage from recovering too rapidly.

The reset action is carried out in much the same way as on our simple board. Pressing the RESET switch raises the voltage at the input of the inverter E (a section of 74S04), so that the output goes low, causing a reset. When the RESET button is released, the capacitor C6 ensures that the return is not too fast. The NHOLD input is not used, and is returned to +5V, along with the CONT input.

Now to the keyboard and the display. These are selected as if they were addresses in memory, using signals from A8, A9 and A11. This whole section is enabled when A8 and A11 are both high, with A9 low, so that the addresses beginning with 1001 or 1101 will activate the display and keyboard. These are bytes 09 and 0D, and it is 0D which is used. In addition to these addresses, the READ and WRITE signals are used in decoding, the READ for activating the keyboard and the WRITE for operating the display. Both READ and WRITE signals are used to gate IC12, which provides "scan" waveform – alternately activating display digits or columns of keys.

Visualizing Data

Looking at it all in more detail and selecting display first, data on the data lines is connected to the latches IC9, 10, which are enabled by the 0D address on the address lines and the WRITE pulse from the 8060. The data signals are then written out from a memory location in the ROM which holds the correct pattern for a figure or letter. These data bytes are stored in addresses 010B to 011A, so that when a letter or figure is to be displayed, the microprocessor must first fetch from one of these addresses into the accumulator, and then write out into the address of the display, an address which will start with 0D. The lowest digit of this address (0D00,



The complete Mk14 PCB. Note the on-board keypad to the left — which can be improved by a CT project!

0D01, etc.) selects which one of the eight displays is to be illuminated, so allowing whatever byte is on the data lines to display a letter or digit at that unit. The monitor program will ensure that these addresses are selected in the correct sequence to display both address and data bytes. The selection of the LED unit is done by the decade counter, IC13, using eight of the outputs. In this way, the LED is selected by only the A0 to A2 address lines, but two unused outputs are left available for the bold user who wants to try experimenting with other types of keyboard decoding. The latching and counting which is carried out by IC12, 13 is done whether the display or the keyboard is in use. When data is to be read in from the keyboard, the 0D address activates IC11, and the lower address numbers go through a count sequence. This causes the output lines of the decimal decoder, IC13 to go low, one at a time, in sequence. When a key is pressed, it will deliver a zero to one of the data lines at a time when one particular address is on the address lines. For example, key 2 will deliver a 0 to pin 14 of IC11 when there is a 0 on the 2-output of IC13 and key 2 is pressed. An address of 0D02, with D7 = 0, and D6, D5, D4 = 1 therefore corresponds to key 2. In my copy of the circuit diagram, the key connections from 8 to F had not been shown, but they follow the same pattern as the keys which are shown. Once again, the monitor program has to compare the data inputs at each address with the stored data to determine what byte must be loaded into the RAM.

Plugging In, Turning On

So much for the hardware and what it does. Let's see now

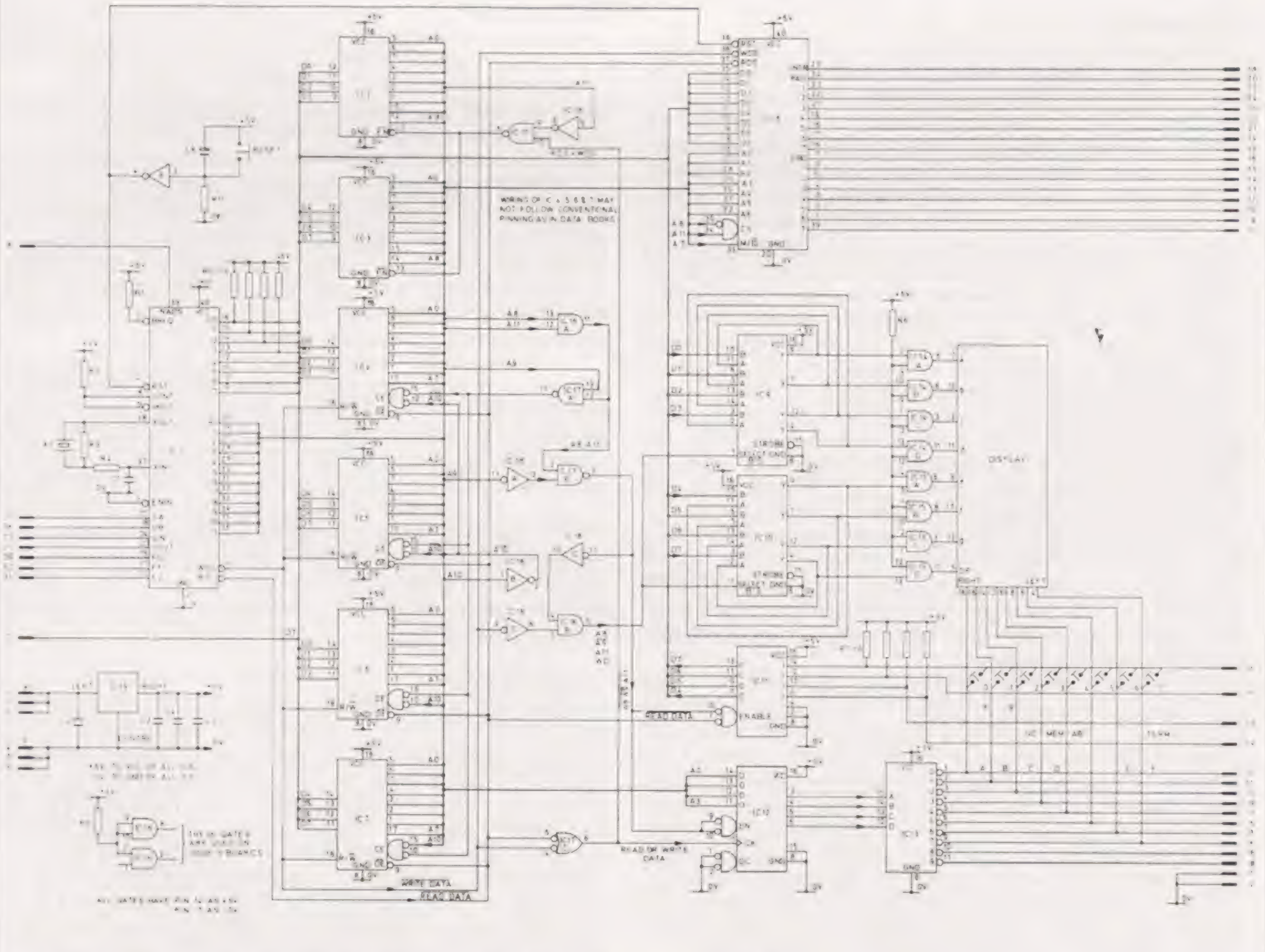


Fig.4. The complete circuit. The older decoding circuit for ROM is shown, and only the first row of keys.

what happens when we start to use it. At switch on, the display should read a bank of zeros. My Mk.14 has nine seven-segment display units, so that the appearance at switch on is of a blank at the left-hand side, followed by four zeros (the address LEDs) two blanks and then two zeros (the data LEDs). This format is used all the way through for the normal display, but as we shall see, it is possible to activate all of the display units and to display letters which are not part of the normal hexadecimal series.

Pressing the RESET button may cause one zero to be brightly lit, or it may extinguish all of the LEDs; either behaviour is quite acceptable. Once the RESET button has been released, it should be possible to key in addresses. This can be done directly, for example, by pressing in sequence, keys 0, F, 1, 2, and will have the effect of setting the address LEDs to the address which is selected, with the data LEDs showing what is stored in the RAM at that address. Don't be surprised at anything you find at 0F12 — this is the start of the RAM memory, and 'garbage' is always found there when you have just switched on. Later in this series, we'll look at a short program for clearing the memory, but for the moment it's important only in one respect. That important provision is that you should let the microprocessor use only that bit of memory which you've programmed. If, for example, your program starts at address 0F20, then you can't let the microprocessor run from 0F1F (the address before 0F20, in case you're not used to hexadecimal). If you do start at 0F1F, and there is some garbage stored there, then the garbage at 0F1F will be read as an instruction to the microprocessor. Worse still, your first program instruction may be read as a data-byte rather than as an instruction — remember that many bytes may be taken either as data or instructions. Similarly at the end of a program, you want the microprocessor to stop stepping through memory and return to the monitor program so that the display can operate. We'll emphasise this point again as we go on, because it isn't at all obvious to the beginner. Meantime, follow the very sound S of C advice to start at address 0000 and single-step through the addresses of the monitor, using the Mem key until you are thoroughly familiar with the sequence of hexadecimal numbers. Don't at this point try to understand what the monitor program data bytes are about — life's too short. Next month we start getting on with elementary programs.

Science of Cambridge have informed us that they will sell the MK14 without the CPU for £39.04 including VAT. Those of you who have built the breadboard may like to take advantage of this.

computing today

WHAT TO LOOK FOR IN THE FEBRUARY ISSUE ON SALE JANUARY 11TH.

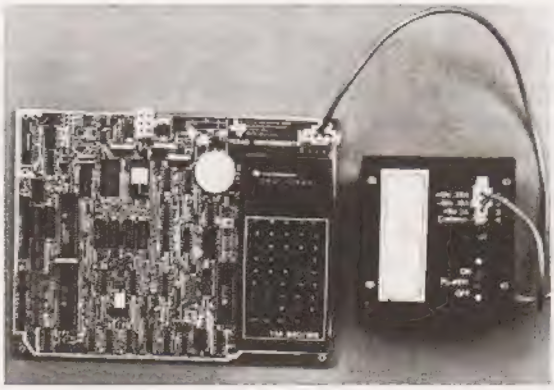
LOGIC EMULATOR

Does your logic lie to you? Do you doubt the truth of your tables? Next month we present a solution to your logic design problems with a software logic emulator for the Nascom. The design caters for the usual range of logic gates and will allow you to try out various input combinations. A must for all who are not up to Mr. Spock's logical capabilities!

MICROLINK

We start a new occasional series on connections you can make with your micro. In the first part we show you how to get your Mk14 or Acorn to flash lights on and off, a vital step for micro-mankind.

TEXAS UNIVERSITY MODULE



There have been evaluation kits and there have been teaching aids. Now there are teaching aids which can double as an evaluation kit! What Texas have produced, however, is a one board education system (TM990/189) which is also an excellent evaluation and to the TMS 9980 16-bit MPU!

A 300 page course comes with the board — along with a hell of a lot else. But is it good value? Can it teach machine code programming as promised? Could it really educate cavement and Spurs supporters? Can it make good tea?

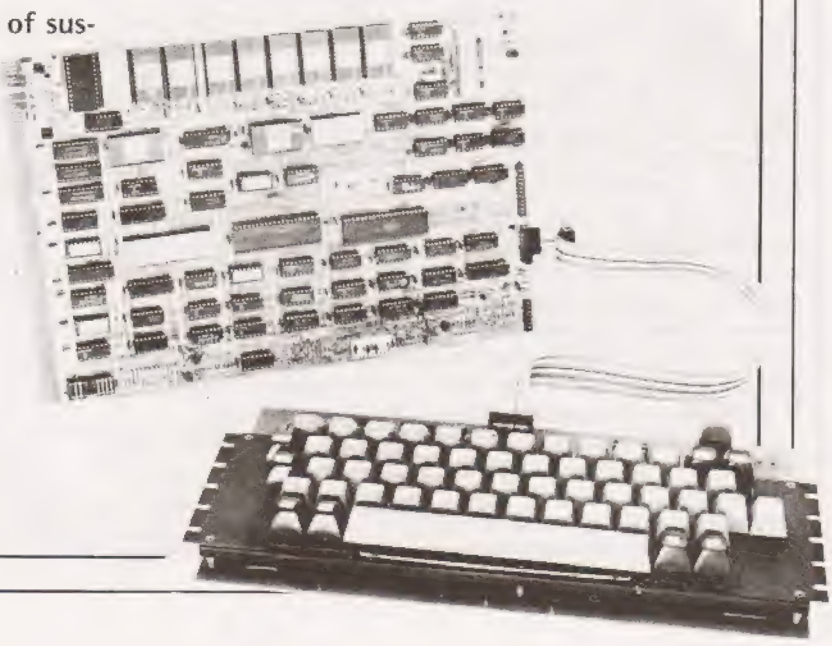
Don't miss next month's stunning inside information when CT reveals all on the TM990/189. The Wews of the Norld will envy us.

NASCOM 2

It has been the most (and longest) awaited home computing system for a considerable time. Everyone we spoke to had heard of it — and knew a great deal about it — but no-one had actually seen it!!!

Well we can put you out of the state of suspense because CT has been examining a Nascom 2 in great detail and will report all that there is to be reported in our next issue.

Whatever you were expecting we can guarantee you that the Nascom is a surprise!



Keith Brindley

A multi purpose power supply suitable for the AIM 65 among others

The CT PSU was designed primarily with ease of construction in mind, although compatibility and a multi-option format were also major factors in its conception. The whole unit consists of basically four separate supplies, providing a wide range of voltages ie. 5 volts; +12 volts; –12 volts; and 24 volts. Each supply is built around a voltage regulator IC which will give a stabilised DC output with a minimum of other components.

Toroidal transformers are used throughout to reduce size and improve performance – they also provide direct printed circuit mounting which minimises flying leads, which can all too often cause short circuits.

Options Available

The PSU can be built in one of three ways; 1) a +5V 5 amp supply and a +24V 1 amp supply, 2) a +5V 5 amp supply and a ±12V 1 amp supply, 3) all three depending on what is required. For instance the AIM 65 board (reviewed last month in CT) was powered by the 5V and the 24V power supply design (the photograph on pages 20–21 of the December issue of CT shows the supply in use and proves conclusively that our designs really do work!)

Obviously you will tailor the CT Power Supply Unit to the requirements of your system depending on voltages and currents needed.

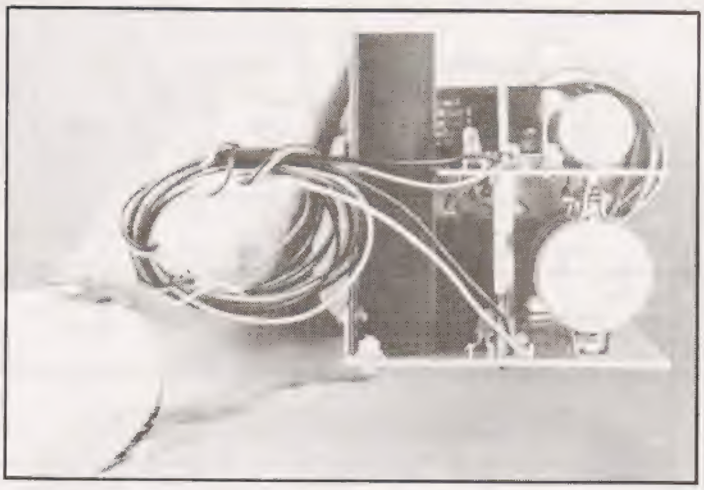
Construction

As in any mains to DC power supply, care must be taken in construction of the project, although the layout of the PCBs does somewhat simplify construction. We suggest that you mount your boards one above another, like ours, although they can be mounted side by side if necessary. We used three lengths of 4 BA threaded brass rod and spacers to hold together the two boards in our supply (+5V and +24V). Slightly longer rod will be needed if all three boards are to be built and constructed in this manner. The brass rod closest to the outputs of the boards grounds the 0 volt lines of the separate supplies together. If the boards are situated in a different manner to that which we recommend then these points should be joined with heavy gauge wire.

Procedures for the three optional constructions will now follow. Option 1, +5V and +24V. The 24 volt board goes above the 5 volt board. It will be necessary to make a cut-out in the top board to allow for the large heatsink, mounted on the bottom board. The top half of this heatsink allows adequate space for mounting IC2 whilst it is still soldered into its relevant position in the 24 volt board. The heatsink is mounted to the lower board with brackets and nylon nuts and bolts to provide electrical isolation. The regulators should be fastened to the heatsink using the usual mica washers and a suitable heatsink compound providing electrical insulation and good thermal conductivity.

The 24 volt board has provision for mains on/off switch SW1, a neon indicator showing mains on, and mains fuses FS1 and FS3. These fuses are for mains voltages so it is advisable to use holders of the fully shrouded type.

Mains connections between the boards ie. Live, neutral and earth are made via 3 short leads to the relevant positions under the 24V board and above the 5V board (try very hard not to get these mixed up!)



Option 2, +5V and ±12V. The procedure here is similar to that of the last except for the fact that the large heatsink is not used for mounting the upper board (±12V) voltage regulators. It will have to be cut short as there is no space therefore for it on the upper board. Instead mount IC3 and IC4 on smaller heatsinks, as shown in the overlays.

SW2 acts as the mains on/off switch in this option and FS1@ acts as the mains fuse for the +5V board.

Option 3, +5V, +24V and ±12V. This option is really only a combination of the last two options. Put the 24V board above the 5V board (after making the cut-out) and mount the ±12V board above this. Take the mains input to the 24V supply as normal, then connect mains from this board to the 5V board and also the ±12V board. It should be apparent that FS1@ on the ±12V board is not now needed and can be omitted in this option.

Finally, if you are not going to case this project then it is advisable to lacquer the copper surface of the bottom board, and as much of the top boards as possible after completion (in particular the mains I/P sides). Further precautions should be taken when the supply is to be used, making sure that the supply is not on a conducting surface. .

HOW IT WORKS

The 5V supply will quite happily provide well over 4 amps at 5 volts, this is achieved by using IC1, a 5 volt 5 amp voltage regulator IC, which stabilises the rough DC voltage across the computer grade smoothing capacitor C1. Because of the high power involved IC1 needs to be mounted on a substantial heatsink. Output fuse FS2 protects the supply against short circuit and should be a quick blow type (2.5 amp when used with AIM 65). LED 1 indicates operation of this supply.

The 24 volt supply is identical in operation but uses IC2 – a 24 volt voltage regulator which will provide 1 amp. The AIM 65 takes an average current of 0.5 amp at 24 volt but peaks at over 2 amps. Fuse FS4, a slow blow 1 amp fuse allows these peaks to occur with no detriment to the running of computer or power supply. LED 2 indicates operation of this supply.

The ±12V supply uses two voltage regulators, a +12V type and a –12V type, both rated at 1 amp which operate in identical fashion to those above. LED 3 indicates operation. Output fuses FS6 and FS7 are of course dependent on the use to which the supply will be put (as are the output fuses of the other two supplies).

POWER SUPPLY PROJECT

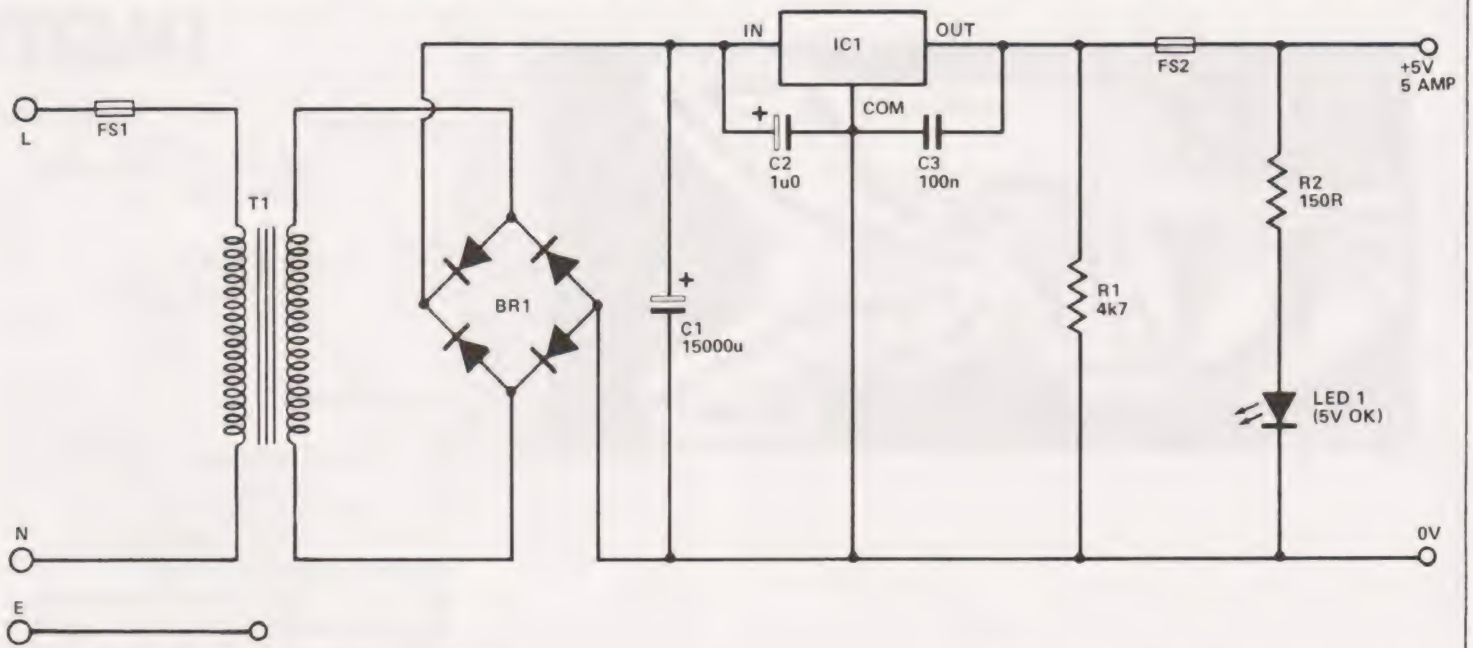


Fig.1. The circuit diagram of the 5V power supply.

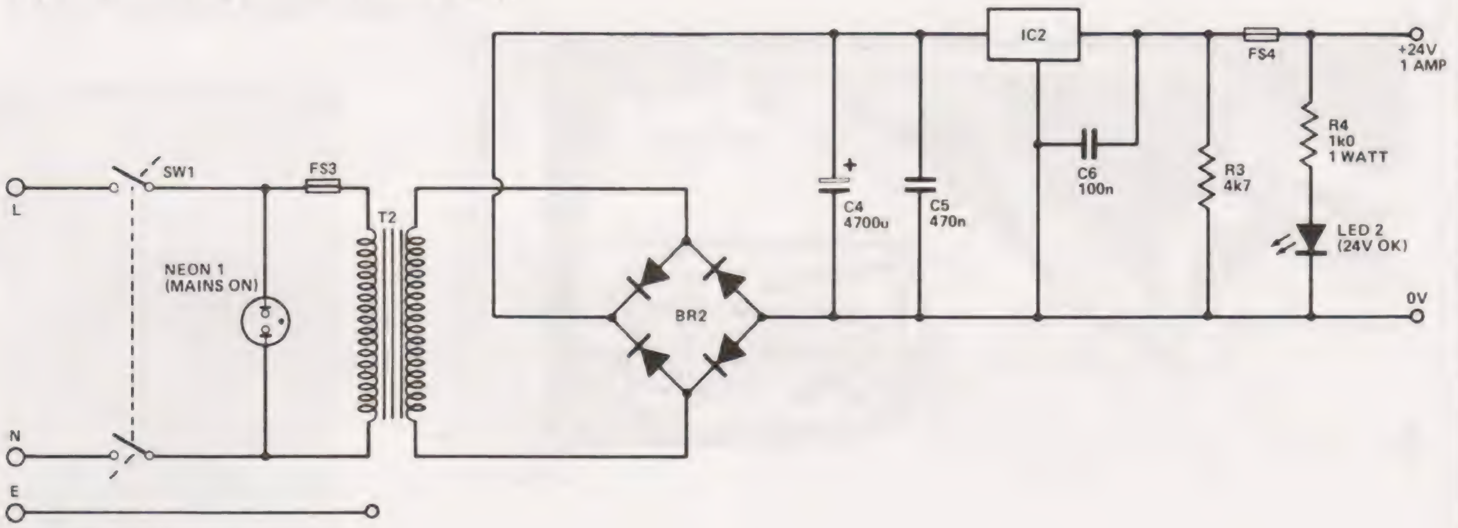


Fig.2. The 24V power supply circuit.

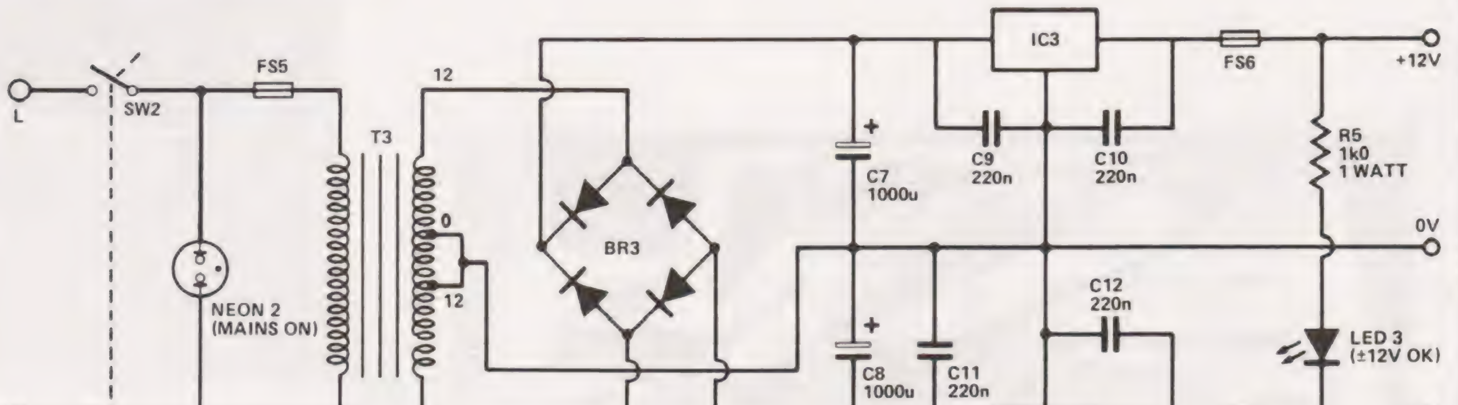


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Fig.3. The ±12V power supply circuit diagram.

NOTES:
IC1 IS 78H05
IC2 IS 7824
IC3 IS 7812
IC4 IS 7912
BR1 IS 200V 6A
BR2,3 ARE 200V 1A
LED1,2,3 ARE TIL209
T1 IS 6-0-6 50VA TOROIDAL
T2,3 ARE 12-0-12 20VA TOROIDAL

Fig.4. The three foil patterns, +5, +24 and ±12 volts top to bottom.

PARTS

RESISTORS

	All ¼W, 5% unless otherwise stated.
R1,3	4k7
R2	150R
R4,5	1k0 1 Watt

CAPACITORS

C1	15000uF 16 volt, Computer Grade.
C2	1uF Tant 25V (or PCB mounted Electrolytic
C3,6	100nF Polyester
C4	4700uF 40V Electrolytic
C5	470nF Polyester
C7,8	1000uF 25V Electrolytic
C9,10,11, 12	220nF Polyester

Please note that as the Eurocard foils are too large to go on our page they are reproduced half size. Full size pat-

LIST

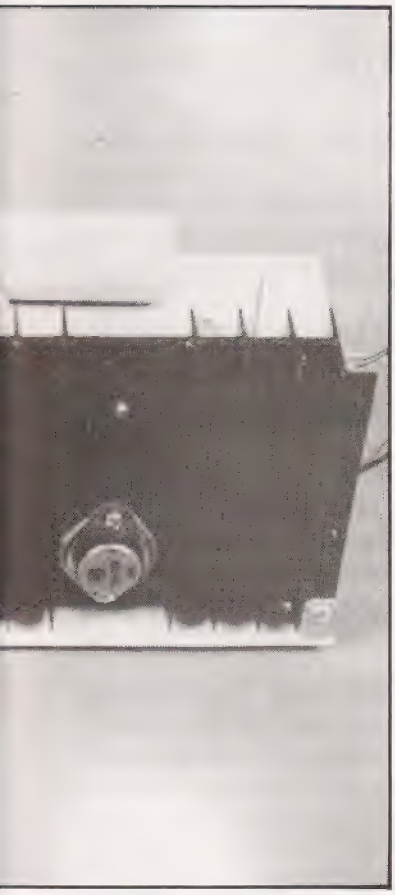
SEMICONDUCTORS

IC1	78H05
IC2	7824
IC3	7812
IC4	7912
BR1	200V 6 amp Bridge Rectifier.
BR2,3	200V 1 amp Bridge Rectifier.
LED1,2,3	TIL 209 or similar LED

MISCELLANEOUS

T1	6-0-6 volt 50VA Toroidal Transformer.
T2,3	12-0-12 20VA Toroidal Transformer.
SW1,2	DPDT PCB mounting switch

2 x indicator neons
4 x shrouded PC mounting fuseholders + fuses (2 amp).
3 x open PC mounting fuseholders + fuses.



terns are available from our offices on receipt of a large SAE, please mark your envelopes "PSU foils".

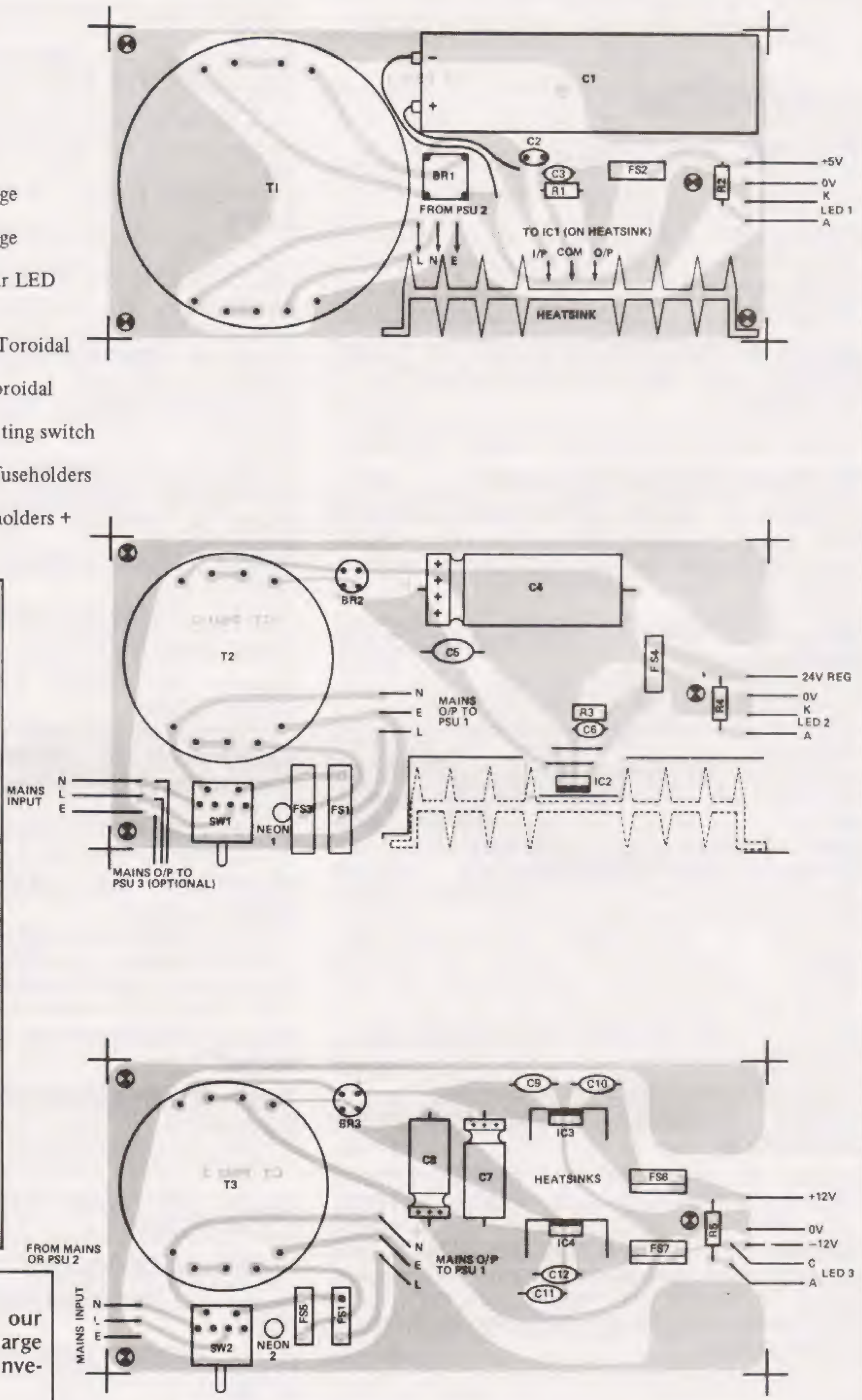


Fig.5. The corresponding overlays for the foil patterns.

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P.J. Marshall.

Can you break the bank before you lose your stake? Can you bluff the dealer? Well, find the answers in this game

For those of you who cannot afford to attend such salubrious gambling establishments as Monte Carlo this Pontoon program will provide a suitable companion. The game is written in a conversational mode so it will be easy to convert to suit your own system. For those of you who are not familiar with the ASCII code set lines 10 and 20 may be replaced with a suitable screen clearing routine.

The program contains a number of interesting routines which handle the dealing and sorting of the cards and the computer will assess the value of its own hand. A number of options are available such as sticking, twisting and buying with your hand as well as burning if your hand value total is thirteen.

To make the program as universal as possible no graphics are used so there is plenty of scope here for improvement and modification.

```
0010 PRINT CHR$(26)
0020 PRINT CHR$(7)
0030 PRINT
0040 PRINT "THIS IS A PONTOON
     PLAYING PROGRAM"
0045 C5=100
0046 P5=100
0047 X5=0
0050 PRINT
0060 PRINT "WE EACH HAVE £100 TO
     PLAY WITH.  THE ANTE IS £3"
0070 PRINT
0080 PRINT "WHEN I HAVE DEALT THE
     CARDS AND TOLD YOU WHAT
     YOU HAVE."
0090 PRINT "YOU MUST EITHER
     STICK TWIST OR BUY."
0100 PRINT "YOU CAN BUY CARDS
     FOR UP TO £10, NO MORE"
0110 PRINT
0112 PRINT "YOU MAY BURN YOUR HAND
     AT ANY TIME BY TYPING  C ."
0113 PRINT "PROVIDED , OF COURSE ,
     YOUR HAND-VALUE IS 13"
0115 PRINT
0120 PRINT "TO SPECIFY WHAT YOU
     WANT TO DO, TYPE 'S','T'
     ,'B' , OR 'C' "
0125 C5=C5-3
0126 P5=P5-3
0127 X5=X5+6
0130 P1=0
0140 P2=0
0200 FOR I=1 TO 10
0210 A(I)=INT(53*RND(0))
0215 IF A(I)=0 THEN 210
0216 IF I<2 THEN 250
0220 FOR J=1 TO I-1
0230 IF A(J)=A(I) THEN 210
0240 NEXT J
0250 NEXT I
0260 FOR I=1 TO 10
0270 K=A(I)
0280 GOSUB 2000
0290 REM GO AND FIND OUT WHAT CARD
     IT IS AND HOW MANY IT COUNTS
0300 NEXT I
0400 A=2
0410 B=1
0420 GOSUB 2400
0440 N1=N
```

```
0442 IF A=5 THEN IF N1<22 THEN 2600
0450 GOSUB 2500
0455 IF G$="S" THEN 470
0456 IF G$="C" THEN IF N=13
     THEN 200
0460 GOSUB 2400
0462 IF N>21 THEN 800
0465 GOTO 440
0470 IF N1<16 THEN 450
0471 PRINT
0475 C=A
0480 PRINT "RIGHT THEN...
     HERE I GO,..."
0490 B=6
0500 A=2
0510 GOSUB 2400
0515 GOSUB 2050
0520 N2=N
0530 IF N<22 THEN IF A=5 THEN 2650
0531 IF N<16 THEN 600
0532 IF N2>18 THEN 540
0533 IF (19-N2)/10<RND(0)/3
     THEN 540
0534 GOTO 600
0535 PRINT
0540 PRINT "I'M STICKING WITH
     WHAT I'VE GOT"
0545 PRINT
0550 IF N1=21 THEN IF C=2 THEN 1000
0551 IF N2=21 THEN IF A=2 THEN 1060
0552 IF P1*P2 > .5 THEN 560
0553 IF N1=N2 THEN IF P2=1 THEN 560
0554 IF P1=1 THEN 900
0555 IF N1>N2 THEN 900
0560 PRINT "***********
     I WIN    ***********"
0570 PRINT
0580 GOTO 960
0600 PRINT "I'LL TWIST"
0601 GOSUB 2050
0610 A=A+1
0620 GOSUB 2400
0625 N2=N
0630 IF N>21 THEN 700
0640 GOTO 520
0700 PRINT "I'VE BUSTED
     ...... DAMMIT!"
0720 PRINT
0730 GOTO 900
0800 PRINT "YOU'VE BUSTED"
0810 PRINT
0820 GOTO 560
0900 PRINT "***********
     YOU WIN   ***********"
0910 PRINT
0920 P5=P5+X5
0925 PRINT " YOU NOW HAVE £";P5
0926 PRINT " I NOW HAVE £";C5
0927 PRINT
0930 PRINT
0935 X5=0
0940 GOTO 120
0960 C5=C5+X5
0970 GOTO 925
1000 PRINT
1010 PRINT "YOU HAVE A PONTOON!!"
1020 PRINT
1030 GOSUB 2050
1040 P1=1
1050 GOTO 551
1060 PRINT "I HAVE A PONTOON!!"
1070 PRINT
1080 P2=1
1090 GOTO 552
2000 L=0
```

```
2005 IF K<14 THEN 2100
2010 K=K-13
2020 L=L+1
2030 GOTO 2005
2050 F=0
2060 F=F+1
2070 IF F<30 THEN 2060
2080 RETURN
2100 B(I)=K
2110 IF K=1 THEN A$(I)="ACE"
2120 IF K=1 THEN IF I<3
     THEN B(I)=11
2121 IF K=1 THEN IF I>2
     THEN B(I)=1
2122 IF K=1 THEN IF I>5
     THEN B(I)=11
2123 IF K=1 THEN IF I>7
     THEN B(I)=1
2130 IF K=2 THEN A$(I)="TWO"
2140 IF K=3 THEN A$(I)="THREE"
2150 IF K=4 THEN A$(I)="FOUR"
2160 IF K=5 THEN A$(I)="FIVE"
2170 IF K=6 THEN A$(I)="SIX"
2180 IF K=7 THEN A$(I)="SEVEN"
2190 IF K=8 THEN A$(I)="EIGHT"
2200 IF K=9 THEN A$(I)="NINE"
2210 IF K=10 THEN A$(I)="TEN"
2220 IF K=11 THEN A$(I)="JACK"
2230 IF K=12 THEN A$(I)="QUEEN"
2240 IF K=13 THEN A$(I)="KING"
2250 IF K>10 THEN B(I)=10
2260 IF L=0 THEN B$(I)="HEARTS"
2270 IF L=1 THEN B$(I)="CLUBS"
2280 IF L=2 THEN B$(I)="DIAMONDS"
2290 IF L=3 THEN B$(I)="SPADES"
2300 RETURN
2400 N=0
2402 PRINT
2410 IF B=1 PRINT "YOU HAVE"
2420 IF B=6 PRINT "I HAVE"
2430 PRINT
2440 FOR S=B TO (B+A-1)
2450 PRINT "****  ";A$(S);
     " OF "; B$(S)
2460 N=N+B(S)
2470 PRINT
2480 NEXT S
2485 IF N=22 THEN IF A=2 THEN 2700
2490 PRINT "HAND VALUE ";N
2492 PRINT
2495 RETURN
2500 INPUT "WHAT DO YOU WANT
     TO DO",G$
2502 IF G$="C" THEN 2580
2510 IF G$="S" THEN 2570
2520 IF G$="T" THEN 2560
2530 IF G$="B" THEN 2550
2540 GOTO 2500
2550 PRINT
2551 INPUT "HOW MUCH FOR ",Q
2552 IF Q>10 THEN 2551
2553 P5=P5-Q
2554 C5=C5-Q
2555 X5=X5+2*Q
2556 PRINT "O.K.
     I'LL MATCH THAT !"
2557 PRINT
2560 A=A+1
2570 RETURN
2580 IF N=13 THEN 2570
2590 GOTO 2500
2600 PRINT
2610 PRINT "YOU HAVE A
     FIVE CARD TRICK"
```

```
2620 PRINT
2630 GOTO 900
2650 PRINT
2660 PRINT "I HAVE A
     FIVE CARD TRICK !!"
2670 PRINT
2680 GOTO 560
2700 B(B)=1
2710 N=12
2720 GOTO 2490
```

"I THINK I'LL STICK WITH HER'S!"

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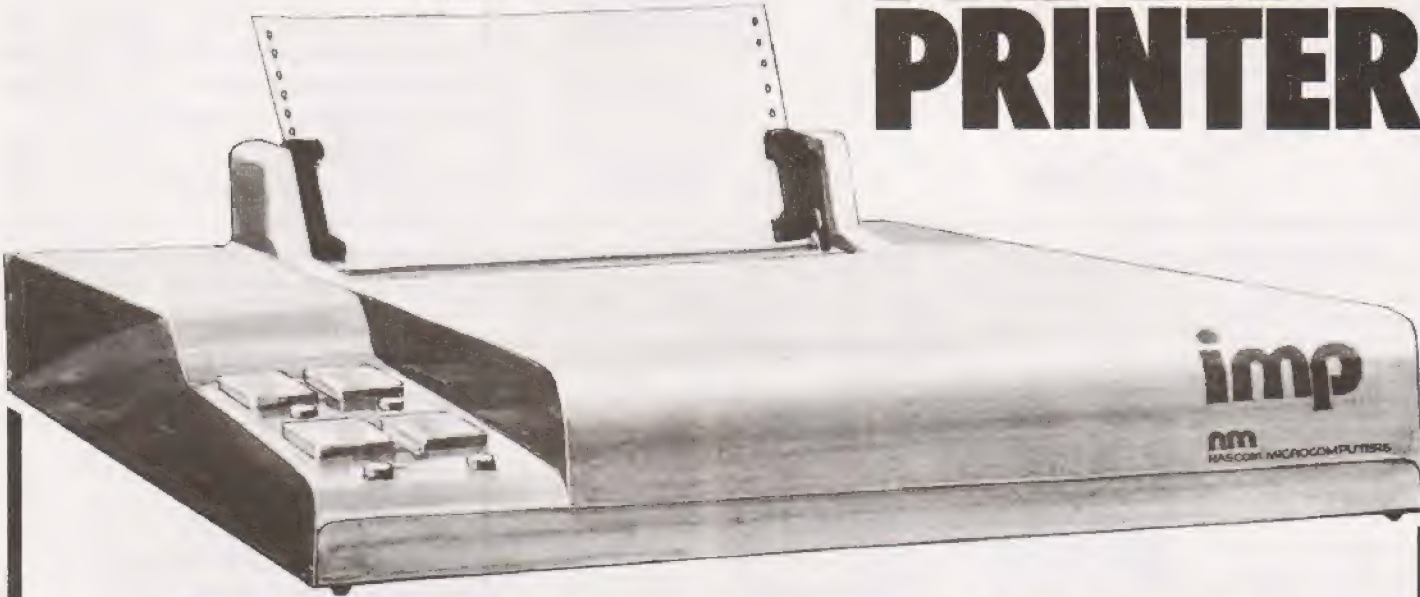

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AD INDEX

Owen Bishop

QUICK KEYBOARD

To go with our MPU series we have a replacement keyboard for the MK14

Although it is generally agreed that the Mk-14 is exceptionally good value for money, most reviewers have singled out the keyboard as the main feature for criticism. Fortunately, Science of Cambridge have already provided at the front end of the board an edge-plug to which an external keyboard can easily be connected.

Buy Or Build

Hexadecimal keyboards or keypads can be purchased ready-made but it is cheaper to make your own. Furthermore, the home-made version is specially designed to be mounted directly above the integral keyboard of the Mk-14 with the display in its natural place beyond the edge of the keyboard and the 'Reset' button to the right (Fig.1). The keyboard and Mk-14 board are mounted on a rectangle of plastic-surfaced chip-board on which there is room to mount the power-pack, the tape interface board or any other devices that are permanently or occasionally attached to the microprocessor system. It is wise to make the mounting board a little larger than you think it need be, to accommodate any additional devices that might be added to the system in the future.

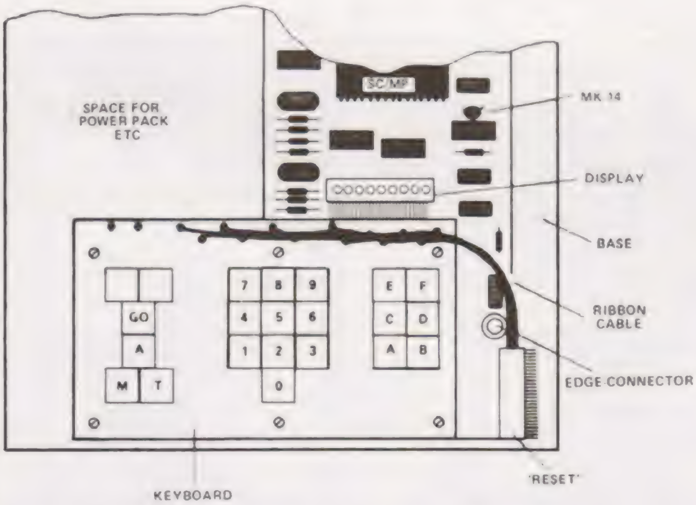


Fig.1. The layout of the system with the new keyboard.

The 16-way edge-plug is shown in Fig.2. Pads 1 to 4 are connected to the input terminals of a tri-state buffer (IC11). The outputs of this buffer are connected to four lines of the address bus. The potential of each input terminal is normally held high (+5 V) because each is connected to the +5 V rail through a resistor (R7-R10). Pads 5 to 14 are connected to the outputs of a BCD-to-decimal decoder. Each output is normally high, but each in turn carries a brief low pulse (0 V) in regular sequence under the control of the microprocessor clock. When a key is pressed, one of the decoder outputs is connected to one of the buffer inputs. The list to the left of Fig.2 shows which keys make which connections. A low pulse from one of the decoder outputs is thus routed to one of the buffer inputs and a pulse appears on one of the lines of the address bus. The microprocessor receives this pulse and, by noting which line it arrives on and the exact timing of its arrival, can tell which key has been pressed. The function of the keyboard is simply to make the correct decoder-buffer connections.

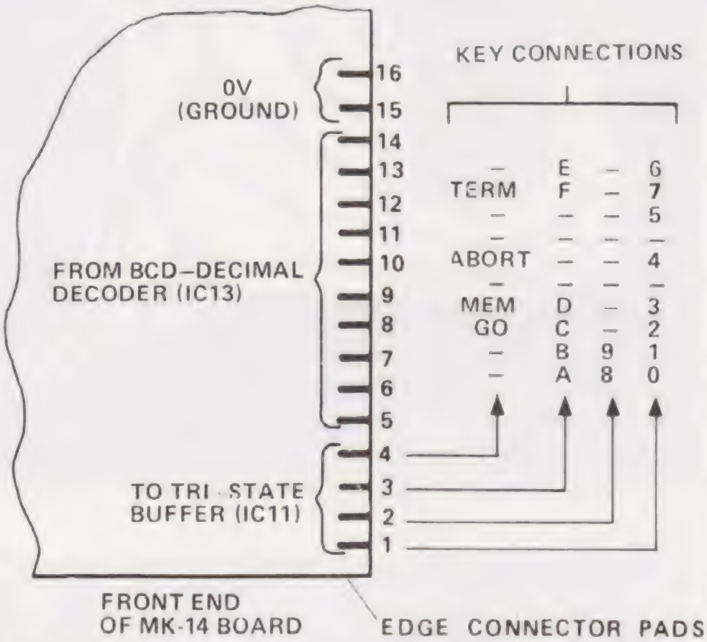


Fig.2. Connections to the Mk-14 edge connector.

The keyboard PCB foil layout. Don't let the solder get bridged!

Keyboard Layout

The arrangement shown in Fig.3 has proved very satisfactory in practice. There is a central block of numerical keys, which are set out as on a conventional calculator keyboard. To the right is a block of letter-keys to complete the hexadecimal set. To the left is a block of 4 command keys, GO, ABORT, MEMORY, TERMINATE. This arrangement brings the two most frequently used keys to the front of the keyboard. The prototype was built as part of an expandable system, so two additional keys were provided for when the board was etched, even though at that stage it had not been decided how they would be used. These keys connect pins P and Q to

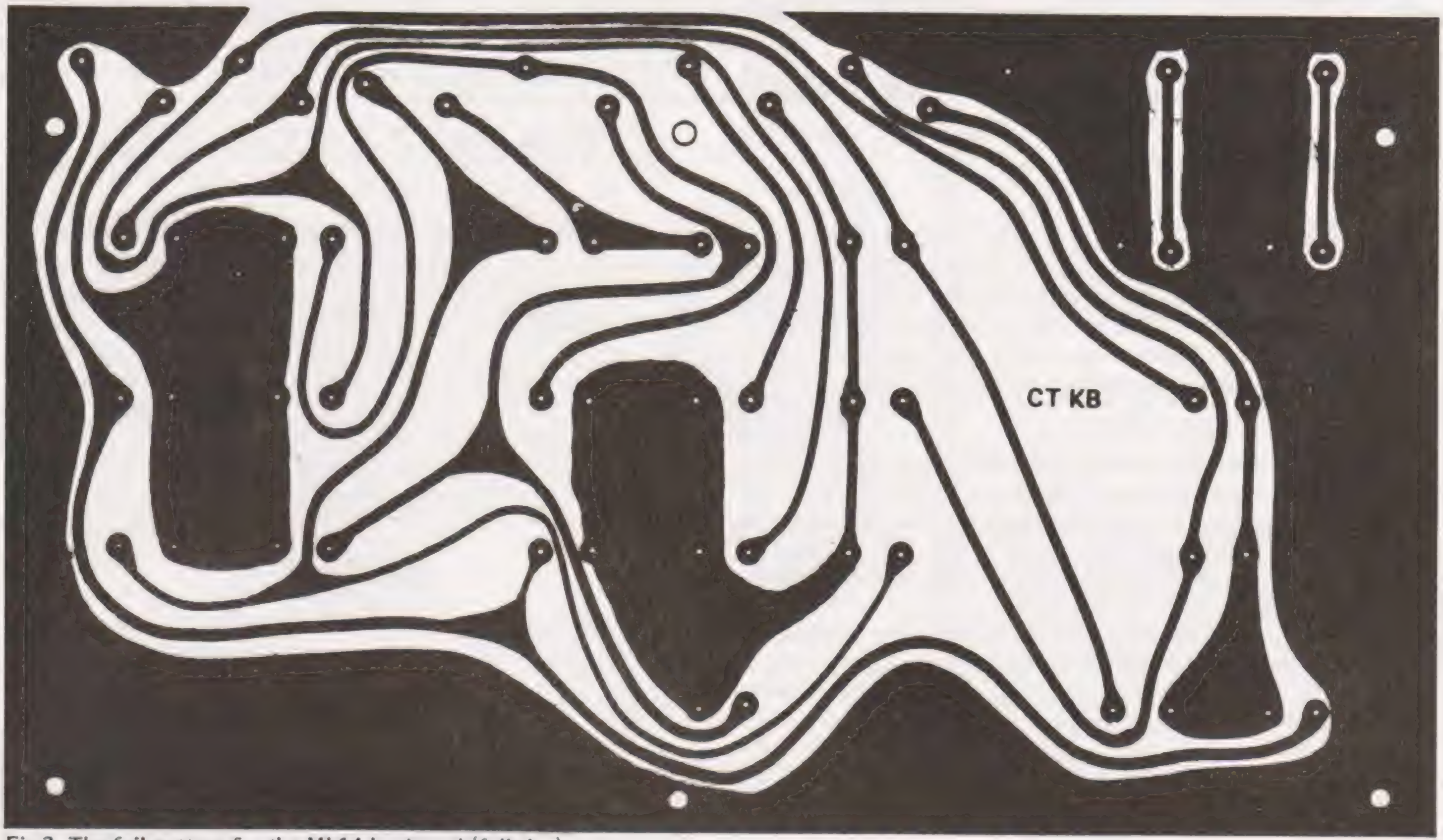


Fig.3. The foil pattern for the Mk14 keyboard (full size).

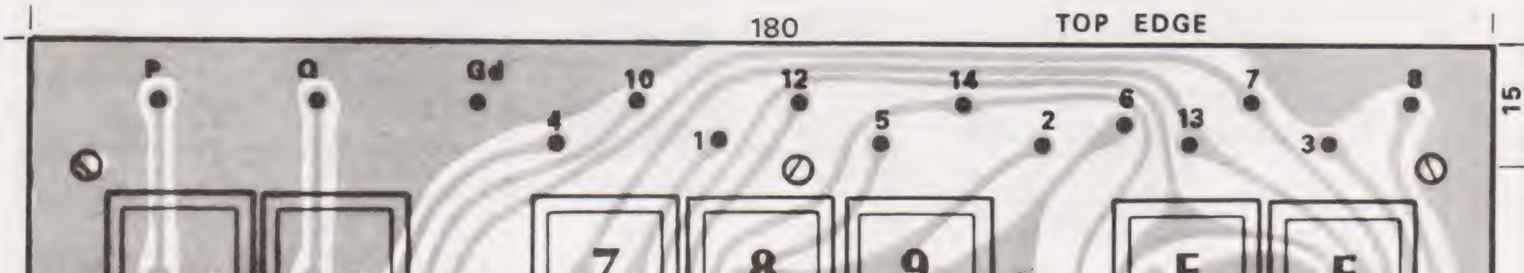
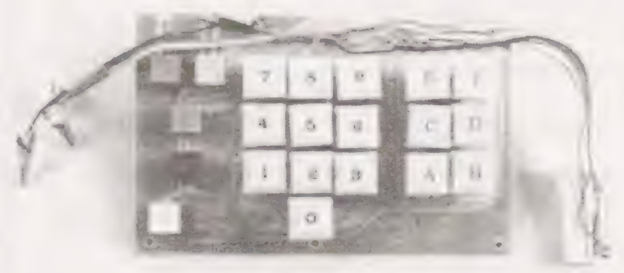


Fig.4. The overlay of components for the Mk14 keyboard.

PARTS LIST

PCB to pattern.
16 way 0.1" edge connector.
20 keyboard switches + tops.
2 keyboard switches and tops for options.
20 way ribbon cable.



A plan view of the prototype Mk-14 replacement keyboard. Note the standard calculator style layout.

ground (0 V) and have several possible uses:

- to provide inputs to Sense A and Sense B, making it possible to control the microprocessor while a program is running
- to control various peripheral devices
- to operate the automatic keying device to be described in a later article.

If you decide not to include these two keys, black out that part of the PCB design and omit pins P, Q and Ground. Ground.

Construction

A firm base is required for mounting the keys, so the keyboard should be constructed on fibre-glass board rather than on Srbp board. The most tedious part of construction is the drilling of the holes for the key terminals. Use a 1.6 mm drill for this and align the holes as accurately as you can. Slight inaccuracies show up on the finished keyboard as uneveness is in the rows of key tops, giving the board an unproffessional appearance. The holes for the connecting pins should be drilled with a 1 mm bit.

It has been found in practice that keys of the recommended type have a clean action, so no debouncing circuit is required. The connecting pins on the board are wired directly to the edge-connector, it is preferable to use ribbon cable. Thirteen wires are required (only 12 if you are not including the extra keys) so use 10-way cable with 2 or 3 additional wires, or 20-way cable with unwanted wires peeled away. For neatness and to keep the cable out of the way of the 'Reset' button and the display, the ribbon should be kept flush with the boards (Fig.1). Wires to the right-hand end of the row of connecting pins are cut progressively shorter and soldered in place in order. Similarly wires to the upper end of the edge-connector are shorter than those to the lower end. When soldering to the edge-connector, lay it on the bench beside the keyboard in the position which it will occupy when finally plugged on to the Mk-14 board.

Mounting The Board

Details of mounting are shown in Fig.5. The original keyboard plate, legend sheet, contact sheet and separator are removed before mounting the Mk-14 board. Bolts pass through the four holes at the centre and right of the keyboard and through the four holes originally used to hold the Mk-14 keyboard. The left-hand end of the keyboard is supported on two further bolts.

The recommended key-switches are in three parts: the switch itself, a square white plastic key-top, and a cover of transparent plastic that clips over the key-top. The key-tops are marked by using rub-down lettering. Capitals and numerals in 20-point size are most suitable. For the command keys, you can use lettering or you may prefer to insert small squares of coloured paper — a different colour for each command. The transparent covers are then clipped over the tops and protect the lettering against wear.

If you are a keen handyman, you may choose to box in the whole unit, leaving holes for the blocks of keys, the display and the 'Reset' button. Remember to allow for ventilation in the region of the power regulator IC. On the other hand, a full view of 'the works' is not only more impressive but is perfectly acceptable for a development system of this kind, so there is no need to do anything further. Simply switch on and enjoy the feel of a smooth-acting full-size keyboard.

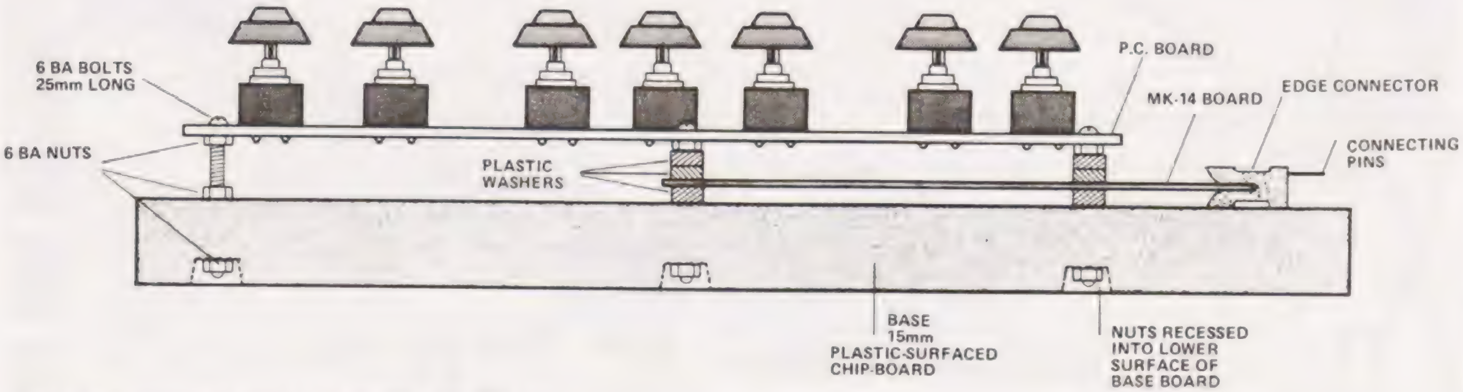
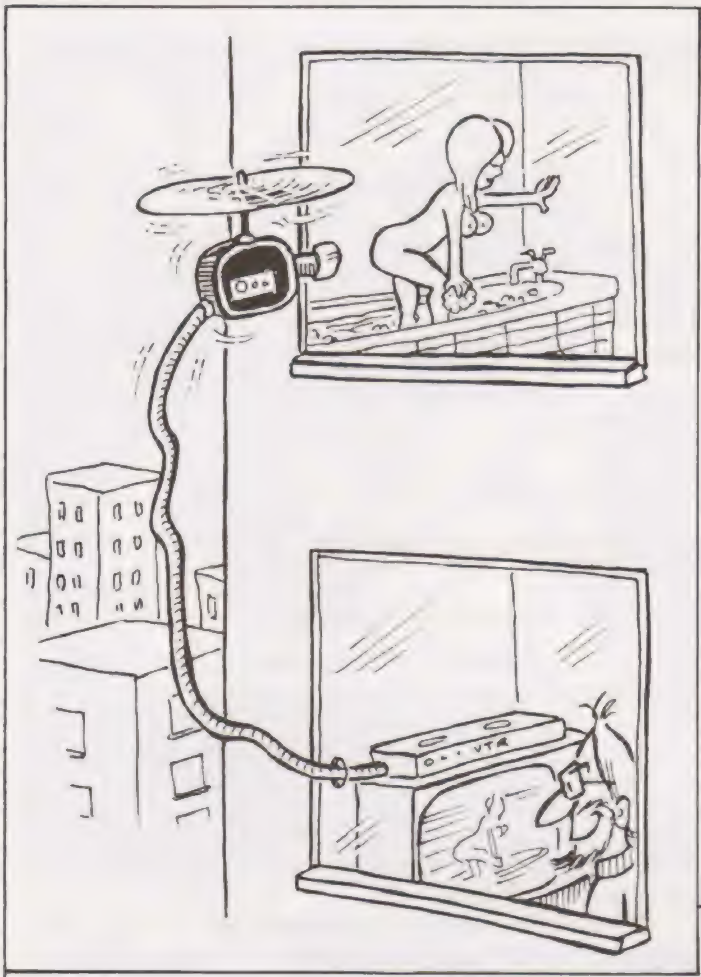
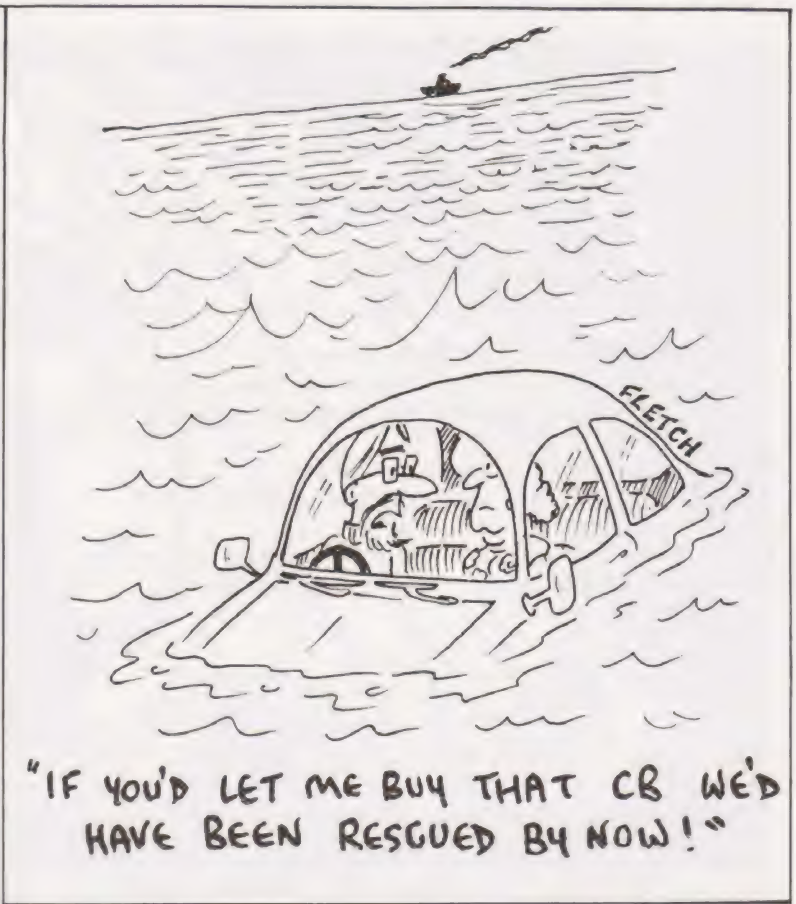
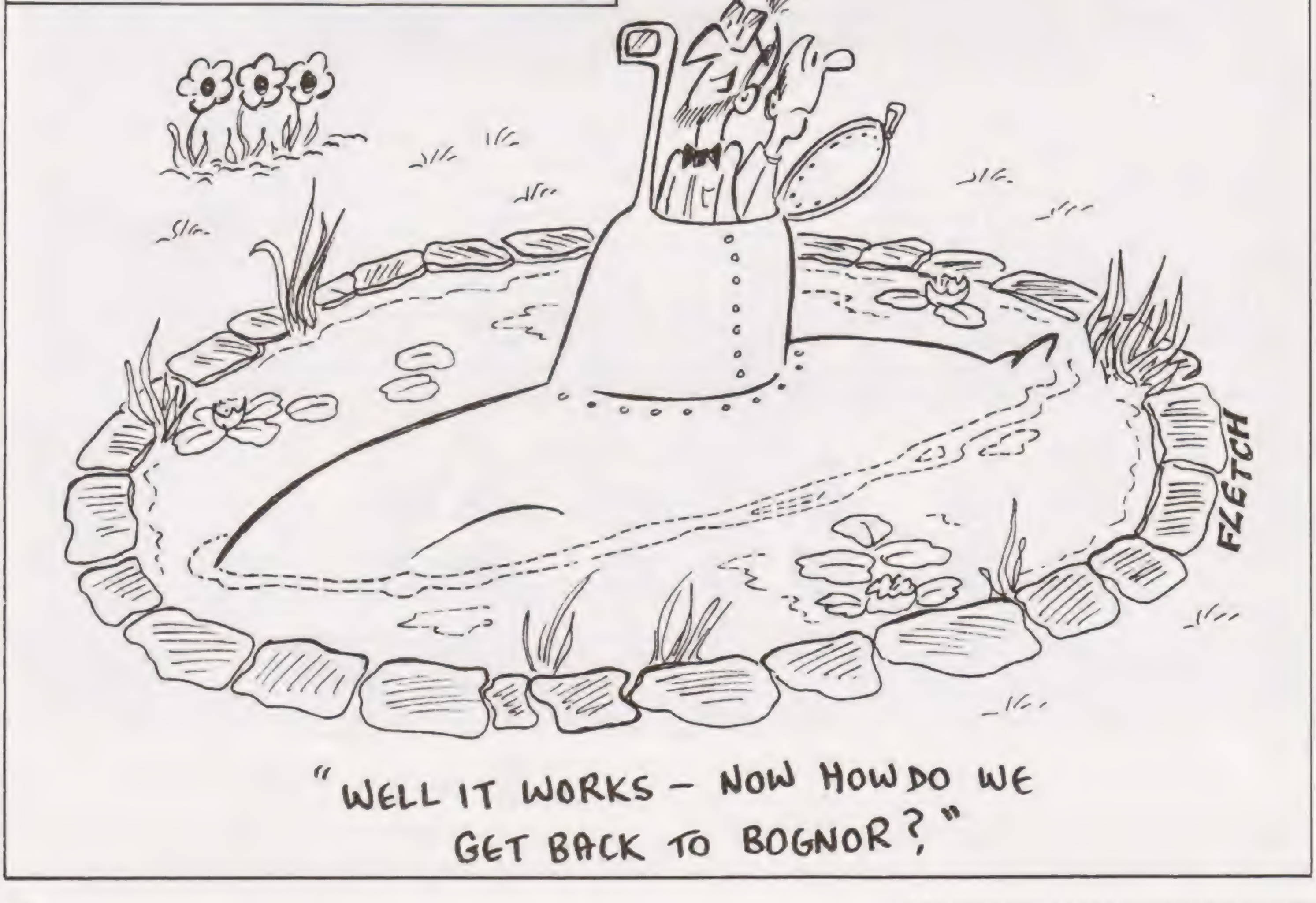


Fig.5. The mounting details for the new keyboard unit.

FLETCH


VTR


FLETCH
"IF YOU'D LET ME BUY THAT CB WE'D HAVE BEEN RESCUED BY NOW!"


FLETCH
"WELL IT WORKS – NOW HOW DO WE GET BACK TO BOGNOR?"

CLUB SURVEY

A complete update on our club file

When we published our Club Survey in July we made one or two errors and omissions owing to lack of communications from the clubs. This survey has been collated from the latest information that we have and if your club has not been included please write and tell us about it. We would like to extend our grateful thanks to all those clubs who have taken the time and trouble to keep us informed, please keep the information coming so we can continue to update our records.

REGIONAL GROUPS

Avon

BRISTOL COMPUTING CLUB
Leo Wallis,
6 Kilbernie Road,
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Avon BS14 0HY

0272-832453

30 members, £3 sub, 3rd Wednesday monthly meetings, Independent club.

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S.W. Rabone,
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Worle,
Weston Super Mare,
Avon BS22 9JW

0934-513068

25 members, £2 sub, Alternate Wednesday meetings, skilled and non skilled sub groups, use of Tech equipment.

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Chester,
Cheshire.

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Pinhoe,
Exeter, Devon.

0392-69844

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Gidea Park,
Romford,
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M.P. Pullin,
45 Merestones Drive,
The Park,
Cheltenham,
Gloucestershire GL50 2SU

0242-25617

25 members, Free membership, Fourth Wednesday monthly meeting at NGCT, Prom programming, 6800 and 6809 systems.

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SOUTHAMPTON AMATEUR COMPUTER CLUB
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c/o Dept of Physiology,
The University,
Southampton,
Hampshire SO9 3TU

Paul Maddison Winchester 4433 ext. 6955

50 members, £3 sub, £2 for students and OAP, 1st Wednesday monthly meeting except July-Sept, Special interest groups, Newsletter "Benchmark".

Hertfordshire

HARROW COMPUTER GROUP
Bazyle Butcher,
16 St. Peter's Close,
Bushey Heath,
Watford,
Hertfordshire W82 3LG

01-950 7068

40 members, Free membership, Alternate Wednesday meetings at Harrow College of FE or Travellers Rest, Kenton, Magazine library.

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22 Wheatfield Gardens,
Belfast 14.

0232-749379

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Diarmuid McCarthy,
7 St. Kevin's Park,
Kilmacud, Blackrock,
Co. Dublin, Eire.

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0634-56830 or 0634-64121

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YAMCO
Nigel Sutcliffe,
1 Suncliffe Road,
Higher Reedley,
Nr. Burnley,
Lancashire.

0282-67677.

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LEICESTERSHIRE PERSONAL COMPUTER CLUB
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11 Gaddesby Lane,
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066474-247

80 members, £2 sub, 2nd Monday monthly meetings, Lectures, Demonstrations, Systems available.

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London W12 UTY

Internal magazine.

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63 Millais Road,
London E11.

£2.50 sub, £1.25 for students, 3rd Tuesday monthly meetings.

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Dept of Electronics and Communications Engineering,
Polytechnic of North London,
Holloway Road,
London N7 8DB

01-607 2789 ext. 2447 or 2172

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Southgate Technical College,
High Street,
Southgate,
London N14 6BS.

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061-881 1933

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Liverpool Polytechnic,
53 Victoria Street,
Liverpool L1 6EY

051-236 0598

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RICHMOND COMPUTER CLUB
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18A The Barons,
St Margarets,
Twickenham,
Middlesex.

01-892 1873

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WEST MIDLANDS AMATEUR COMPUTER CLUB
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Crestwood Park,
Kingswinford,
West Midlands DY6 8SP

0384-70097

£2 sub, £1 students, 2nd Tuesday monthly meetings, Newsletter.

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NOTTINGHAM MICRO–COMPUTER CLUB
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Wollaton,
Nottingham,
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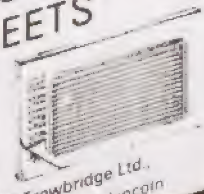

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COMMANDS

CONT LIST NEW NULL RUN

STATEMENTS

CLEAR	DATA	DEF	DIM	END	FOR
GOTO	GOSUB	IF GOTO	IF THEN	INPUT	LET
NEXT	ON GOTO	ON GOSUB	POKE	PRINT	READ
REM	RESTORE	RETURN	STOP		

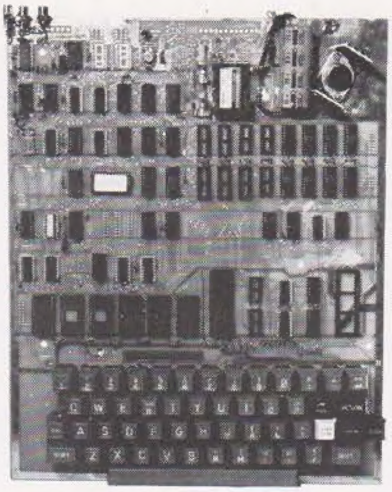
EXPRESSIONS

OPERATORS

+ - * / ↑ NOT AND OR > < <> >= <= RANGE 10^{-32} to 10^{+32}

VARIABLES

A.B.C. ..Z and two letter variables
The above can all be subscripted when used in an array. String variables use above names plus $ e.g. A$



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 Erases last character typed.
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: Separates statements on a line.
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LOG(X)	PEEK(I)	POS(I)	RND(X)
SPC(I)	SQR(X)	TAB(I)	TAN(X)
FRE(X)	INT(X)		
SGN(X)	SIN(X)		
USR(I)			

STRING FUNCTIONS

ASC(X$)	CHR$S(I)	FRE(X$)	LEFT$(X$,I)
RIGHT$(X$,I)		STR$(X)	
LEN(X$)	MID$(X$,I,J)		
VAL(X$)			

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